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CREATIVE INDEXES: ECONOMIC SPACE MATTERS?

by

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Biography

Carlos Miguel de Oliveira Correia was born in Vila Nova de Famalicão on 9 June of 1988.

He did his primary and secondary education studies in his hometown where he lived until moving to Oporto in 2011.

In 2006 he entered the University of Porto School of Economics and Business (FEP - Faculdade de Economia da Universidade do Porto) where he graduated in 2010 in Economics.

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Abstract

Creativity is now seen as the new currency in a global world. It is considered the best intangible resource and, more or less, it is inherent to everyone. While in the previous era, the requirement to attain success was learning how to use, integrate and work with new technologies, nowadays the ability to generate new ideas and to transform them into innovation is the new key to succeed personally, professionally, corporately and socially. Many studies have assessed the importance of creativity as a key driver for economic growth and development. The interest in the estimation of indexes of creativity has been increasing in the last years, not only for territorial marketing purposes, but also, because they provide analytical tools to assess the economic impact of the creative economy and are useful to measure the effectiveness of political decisions.

This dissertation draws attention to the spatial analysis which we consider that has been overlooked by the existing studies on creativity and, consequently, by creativity indexes. It presents a review of creativity literature and a critical review of the creativity indexes industry by selecting the most relevant references among the existing ones. Then it proposes a new index which seeks to fill the gaps and amend the weaknesses of its predecessors. This new indicator is used to measure the creativity on EU-27 states and on Portuguese cities, enabling the spatial analysis at country and city level. Finally, it is proposed a new typology of cities based on their creative performance and their proximity to creative centres which is applied to Portuguese cities using the new index results.

Keywords: creative economy, creativity indexes, spatial economics

JEL Codes: O31, R12, Z1

Resumo

A criatividade é atualmente vista como a nova moeda de um mundo global. É considerada o melhor recurso intangível e, em maior ou menor escala, está inerente a todos os indivíduos. Enquanto que na era anterior o segredo para se ser bem sucedido residia na capacidade de aprender a usar, integrar e trabalhar com as novas tecnologias, nos dias de hoje a capacidade de gerar novas ideias e de convertê-las em inovação é o novo fator de sucesso pessoal, profissional, social e empresarial. Vários estudos analisaram a importância de criatividade como motor de crescimento e desenvolvimento económico. O interesse na estimação de índices de criatividade tem aumentado nos últimos anos, não só devido a objetivos relacionados com marketing territorial, mas também, devido ao facto de serem instrumentos analíticos que medem o impacto económico da economia criativa e são úteis para avaliar a eficácia de decisões políticas.

Esta dissertação realça a análise espacial que nós consideramos ser um assunto negligenciado pelos estudos existentes e, consequentemente, pelos índices de criatividade. Apresenta uma revisão da literatura sobre criatividade e uma análise crítica da indústria de índices de criativade selecionando os mais relevantes entre os existentes. Depois é proposto um novo índice que procura corrigir os pontos fracos e lacunas dos seus antecessores. Este novo indicador é usado para estimar a criatividade dos países da UE-27 e das cidades Portuguesas, permitindo a análise espacial a nível nacional e urbano. Por último, é proposta uma nova tipologia de cidades baseada nas suas performances criativas e na proximidade de centros criativos, a qual é aplicada às cidades Portuguesas usando os resultados obtidos com o novo índice.

Palavras-chave: economica criativa, índices de criatividade, economia geográfica

Códigos JEL: O31, R12, Z1

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1. INTRODUCTION

Creativity and its importance to economic development is, now more than ever, a subject of debate and research both by academic and political institutions. The creative economy is developing fast as it integrates and influences the rest of the economy. The value of world exports of creative goods and services reached $592 billion in 2008, growing at an annual rate of 14 per cent between 2003 and 2008, according to UNCTAD[1].

In the early 1990s, the Nomura Research Institute of Japan already predicted that the "Information Age" would be followed by a fourth era of economic activity, calling it "Creation Intensification"[2]. Daniel Pink (2005) in "A Whole New Mind" endorses the previous classification and defines four Ages of Economic Development as shown in Table 1.

Table 1 - Ages of Economic Development

1	Agriculture Age (farmers)
2	Industrial Age (factory workers)
3	Information Age (knowledge workers)
4	Creative Age (creators and empathizers)

Source: Pink (2005)

Nowadays creativity is seen as the new currency in a global world. It is our best intangible resource and, more or less, it is inherent to everyone. The ability to generate new ideas and to transform them into innovation is the new key to succeed personally, professionally, corporatively and socially, while in the previous era, the requirement to attain success was learning how to use, integrate and work with new technologies.

[1] Source: *Creative Economy Report 2010: A Feasible Development Option*, UNCTAD, 2010.
[2] Source: *Sozo no Senryaku* [Strategy for Creation], Nomura Research Institute, 1990.

Many studies have assessed the importance of creativity as a key driver for economic growth and development at regional and national level (e.g., UNESCO, 2000; Howkins, 2001; DCMS, 1998, 2001, 2004; Florida, 2002, 2004, 2005; Landry, 2000; KEA, 2006; Potts *et al.*, 2008; Throsby, 2008; UNCTAD, 2010). Therefore, it is normal to observe that many policymakers have gained great interest in the creative economy and placed it as an important topic in their political agendas. The pioneer country was the United Kingdom by establishing the Creative Industries Task Force in 1997. Many other countries followed this trend and some are noteworthy. Flanders was the first region to organise the "Creativity World Forum" and one of the founders of the "Districts of Creativity Network" whose conferences have become a world benchmark in creativity discussion, with the participation of government leaders, entrepreneurs and knowledge institutions from the network. In 2002, the Australian Government has developed a report called "Creative Industries Cluster Study". In the same year, the New Zealand Institute of Economic Research published the "Creative Industries in New Zealand: Economic Contribution". More recently in 2011, Brazil has created the Secretariat for the Creative Economy under control of the Department of Culture. Almost every state of the United States of America has a public department, institution or organism dedicated to creativity as a motor of economic development and growth. Also many Asian countries are researching and investing on the creative economy. African countries are starting to take part on creativity matters which they see as a solution to revitalise less developed economies. The European Comission launched the European Year of Creativity and Innovation 2009. Its main goal was to raise awareness to the importance of creativity and innovation contribute to economic prosperity as well as to social and individual wellbeing. Corporations have also perceived the importance of fostering creativity both in workers and managers and the necessity of deepening the knowledge about this phenomenon. Adobe, a world leader in creative media and marketing, has published the "State of Create Study" in April 2012. It was developed to "identify attitudes and beliefs about creativity and provide insights into the role of creativity in business, education and society". It states that creativity is also important for non-creative occupations because it helps dealing with new situations and solving problems.

The bigger awareness of the importance of creativity has increased the demand for measures and indicators to assess creativity. Thus, many creativity indexes have been developed in the last decade. They were requested mainly by policymakers and administrators as they are useful tools to analyse the economic impact of creativity, to support the policymaking process and to measure the effectiveness of political decisions. However, there is still not a superior index commonly accepted and used across the globe.

The results of creativity indexes have already been analysed and explained under several points of view, however little has been done about the role of space in creativity. Although some authors advocate that in a globalised world distance is no longer important, others affirm that location is still a crucial factor for people and industry. One of the aims of this dissertation is to study the relationship of creativity with spatial characteristics and conclude if they really matter or not.

In Chapter 2 we will begin by reviewing the existing literature on creativity as we highlight the adopted concepts and definitions on this dissertation. Due to the ambiguity inherent to the analysed subject, this chapter is vital for an accurate interpretation of all aspects discussed throughout the dissertation. Then we will present a critical review of the creativity indexes universe in which we compare the different frameworks, methodologies and components of eleven indexes that we consider being the main references and a crucial basis for the work developed in this dissertation.

In Chapter 3 is presented a proposal of a new creativity index that seeks to fill the gaps and amend the weaknesses of its predecessors. Then, it is explained its framework, methodology, indicators and respective data sources. Inspired by the lessons learned from the past, it aims to be a superior index and to draw attention to spatial matters. Due to the nature of this disseration it was named the Creative Space Index.

In Chapter 4 we will begin by calculating the Creative Space Index for EU-27 states, and then we will study the relationship of its scores with spatial variables and economic performance. We will compare the results with Richard Florida's Creativity Index, an indubitable reference in creativity indexes, and also with the index results as if it was calculated with an innovative weighting method, first advocated by Melyn and Moesen

in 1991. In both cases the comparison reveals significant differences in the indexes' results.

In Chapter 5 we will calculate the Creative Space Index for Portuguese cities and, analogously to Chapter 4, we will analyse the relationship of its scores with spatial variables.

In Chapter 6 it will be proposed a new typology of cities based on their creative performance and their proximity to creative centres of excellence: the Creative City Matrix. It aims to complement creativity indexes and to support the policymaking and the decision process. This typology will be applied to Portuguese cities using the results obtained in Chapter 5.

2. CREATIVE INDEXES: A LITERATURE REVIEW

2.1. Concepts and definitions

Despite the increase in the literature on the creative economy, it has been produced both by academic and policymakers within different frameworks, with different objectives and built in different contexts. In the literature there is a lack of explanation regarding the concepts used. Many of them are applied interchangeably and synonymously, e.g., "creative industries" and "cultural industries", "creativity" and "innovation". This contributes to the inaccuracy and ambiguity which are already inherent to the subject itself. So, in this section we review the more relevant concepts and definitions used throughout this dissertation.

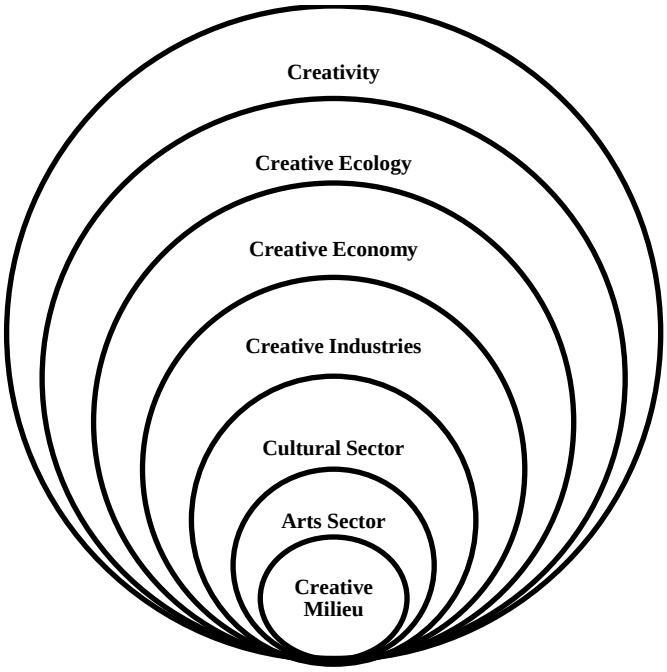

Figure 1 - Creative Concepts Relationship

Source: Author

The relationship of these concepts is resumed in Figure 1. Creativity is a charateristic that, more or less, is inherent to every individual. The Creative Ecology refers to the ecosystem that has influence on creativity, i.e, the systematic interaction between organisms and between them and their environment. The Creative Economy,

conditioned by the underlying ecology, consists of all economic activities which have origin in creativity and result from the action or interaction of people and enterprises in a specific place or community. The Creative Industries are a part of the creative economy and comprise the enterprises and organisations whose main resource is creativity and talent. They contain a narrower group of enterprises, the Cultural Sector, which itself contains the even narrower Arts Sector. The Creative Millieu is the place where creative people and businesses interact. Depending on the scale of analysis, it can be as small as a building or as big as a region, and it can only refer to the Arts and Cultural Sector or to the entire Creative Economy.

A. Creativity

Creativity is a complex phenomenon with multiple dimensions and there is no simple definition that captures all of them. A psychological definition of creativity is "the process of producing something that is both original and worthwhile" (Csíkszentmihályi, 1999). There are many other precise definitions with divergent meanings but all of them generally agree with the one aforementioned. Although this definition claims that creative products have some kind of value, it can be of many different kinds and it is not necessarily economic. It can be social, historical, personal, cultural or symbolic. In fact, for a long time it was presumed that creativity was something without economic value and insusceptible of economic analysis. That is one of the reasons why economists have ignored this subject for research, when compared to other science fields such as psychology and sociology.

The first creativity related economic approach was presented by Schumpeter (1942) introducing and popularising the term "creative destruction" to describe a process of innovation which arises out of the destruction of some established product, reality or order. Another approach is Romer's (1990) "economics of ideas" which defends that unlike physical resources, whose scarcity would pose a limit to growth, ideas are unlimited and have infinite potential. Every new concept can be combined with an existing one, generating another new concept. A psychoeconomic model of the creative process was introduced by Rubenson *et al.* (1992), which postulates that each individual

has natural creative abilities and can enhance them through investments in its creative potential. These investment decisions are based on a cost-benefit rationale. The cost of producing creative outputs and the benefits to the individual and others are factors whose influence in those decisions was proven to be significant. The model also uses the supply and demand analysis to explain the level of creative activities in a particular region (e.g., art, business, research).

B. Creative Ecology

The Creative Ecology studies the relationship between creativity, organisms and their environment. Howkins (2009) argued that creativity results from the mix of four ecological conditions: diversity, change, learning and adaptation. He also pointed out that a proper habitat can be the reason why some ideas prosper while others fail. According to Howkins, the Creative Ecology is a concept that comprises the interaction between individuals conditioned by their environment, how they have ideas and how they use them to develop, collaborate and adapt.

C. Creative Economy

There is no unique definition of this concept, in fact, it is very recent and has been shaped during the last decade. In this section, several relevant approaches will be explained and it will be presented the definition of "creative economy" adopted in this dissertation, which will be a combination of the previous.

This term has gained wider popularity with John Howkins' book "The Creative Economy" which covers the relation between economics and creativity. In this book, the creative economy is defined according to two perspectives. First, he takes a Product Transaction perspective which states that "the creative economy (CE) is equivalent to the value of creative products (CP) multiplied by the number of transactions (T)" (Howkins, 2001).

$$CE = CP \times T \tag{2.1}$$

Secondly, he takes an industry approach which defines the creative economy as a combination of industries classified by their form of intellectual property: Copyright, Patent, Trademark and Design industries.

Table 2 - Creative Economy specific characteristics

Intangible assets
Infinite resources (ideas)
Competition with low barriers to entry
Market driven by demand
Increasing returns
The "currency" is creativity and intellectual property
Increasing marginal utility

Source: (Howkins, 2001)

Another approach was adopted by Richard Florida (2002) taking an "Occupational" perspective. This option faces dificulties on data availability for analysis but highlights the problem that arises with the "Industry" approach: creative industries employ many workers whose work doesn't involve creative tasks or requires creativity; whereas, "Creative Occupations" capture many creative workers, considered individually, who are not assigned to any creative industry.

The New England Foundation for the Arts has combined both "Industry" and "Occupational" approaches into a new framework and adds a third dimension which refers to spatial matters (NEFA, 2007).

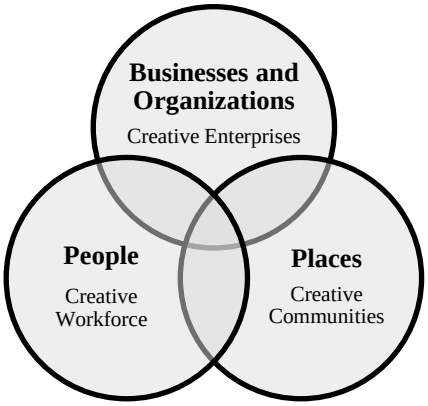

Figure 2 - The Creative Economy

Source: NEFA (2007)

The main hypothesis of this model is that a relatively higher concentration of creative enterprises and creative workers in a geographic area yields a competitive edge by elevating the area's quality of life and improving its ability to attract economic activity.

The UNCTAD definition of creative economy is:

> *"The creative economy is an evolving concept based on creative assets potentially generating economic growth and development. It can foster income generation, job creation and export earnings while promoting social inclusion, cultural diversity and human development. It embraces economic, cultural and social aspects interacting with technology, intellectual property and tourism objectives. It is a set of knowledge-based economic activities with a development dimension and cross-cutting linkages at macro and micro levels to the overall economy. It is a feasible development option calling for innovative, multidisciplinary policy responses and interministerial action. At the heart of the creative economy are the creative industries."*

The definition of creative economy that is going to be adopted in this dissertation is a combination of all the previous approaches and the DCMS (1998) definition of creative industries. Thus, the Creative Economy is an evolving concept, based on creative assets potentially generating economic growth and development (UNCTAD, 2010), that consists of all those activities which have their origin in individual creativity, skill and talent, and which have a potential for wealth and job creation through the generation and exploitation of intellectual property (DCMS, 1998). These activities result from the action or interaction of enterprises, organisations and individuals in a creative place (NEFA, 2007), and can be delineated according to their type of intellectual property: Copyright, Patent, Trademark and Design (Howkins, 2001).

D. Creative Industries

The origin of this term dates back to 1994 with the launch of the report "Creative Nation" in Australia. But only a few years later has it gained wider popularity with the creation of the "Creative Industries Task Force", in 1997, under Tony Blair's administration in the United Kingdom. The definition advocated by this organism considers that creative industries are "'those activities which have their origin in individual creativity, skill and talent, and which have a potential for wealth and job

creation through the generation and exploitation of intellectual property" (DCMS, 1998). The thirteen sectors identified within this framework are listed in Table 3.

Table 3 - Creative Industry Sectors

Advertising
Architecture
Art and antiques market
Crafts
Design
Designer fashion
Film
Interactive leisure software
Music
Performing arts
Publishing
Software
Television and radio

Source: DCMS(1998)

This has been the most used definition in studies related to creative industries. The reason behind its popularity is, not only, the high credibility that DCMS has earned over the years, but also, for being part of a document that challenged the traditional economic perspective on creative industries and that has regarded them as an important economic sector which should be a subject of governments' attention way beyond a simple market failure analysis. The "creative industries" designation marks a historical shift in approach to potential commercial activities that until recently were regarded purely or predominantly in non-economic terms (UNCTAD, 2004).

E. Creative Millieu and Creative City

Creativity is fostered by creative people and by organisations that are attracted to places with specific characteristics and, when all of these three elements come together in one area, they constitute a creative milieu. Depending on the scale of analysis, the Creative Millieu can be a building, a street, a campus, a city, a region or a cluster, among others.

Historically, the city has proved to be the most creative space by nature. It has both hard and soft infrastructures needed to nurture creativity which is stimulated by urbanity

itself – critical mass, density, diversity and interaction. This concept has gained popularity after Landry's (2000) book. According to this author, the Creative City is one that produces cultural goods and services; attracts innovative high-technology enterprises; has networks for exchanging information and knowledge between individuals, enterprises and public sector; organises activities including creative ones in clusters, offers a variety of public spaces of quality and opportunities for leisure, entertainment and self-development; has an effective transport infrastructure and fosters participation and involvement both by inhabitants and tourists.

Many cities call themselves "creative city", but only a few are comprehensively creative, i.e., cities with a global reputation over a long time period and where creativity dominates the urban scene, e.g., New York, Los Angeles, Amsterdam, London, Milan and Tokyo (Landry, 2007).

Not all cities are creative, but every city can increase its creativity. Creative policies must be adapted to the specificities of each city and should be planned and executed within a multidisciplinary and cross-sectorial framework in order to avoid biasing the creative sector itself[3]. That is, a city would benefit more from taking measures considering different policy domains all together (social, cultural, economic and geographic, among others) than if they are taken individually.

[3] "Unlocking the potential of cultural and creative industries", European Commission Green Paper (2010)

2.2. The state of the art on creative indexes

There is a fierce competition going on between cities which has been fostered by globalisation. Nowadays, when one thinks of migrating or travelling is more likely to think of cities attractiveness than of countries characteristics. This competition exists at a global scale, and cities are aware of their competitors at both intranational and international level. Therefore, most cities try to emphasise their attractive features and distinctiveness, and a good way to achieve this is to position themselves on the top of rankings. A good score in an index is a competitive advantage and a great way of attracting people and enterprises. Thus, the demand for creative indexes by policymakers has been increasing in the last few years, not only for territorial marketing purposes but also because they provide analytical tools to assess the economic impact of the creative economy and are useful to measure the effectiveness of political decisions.

The development of creativity indexes emerges from the combination of the need to assess the relationship between creativity and the economy with the lessons learned from many other kinds of indexes – art-based, culture-based, of regions liveability, of global cities and ICT. So, although city performance indexes are not recent, only during the past decade did appear the first studies and the development of creativity-based indexes. Among the many existing indexes we have selected eleven we consider being the more relevant and indubitable references in creativity indexes literature. They will be presented by chronological order for a better understanding of their evolution over the time.

2.2.1. Florida's Creativity Index (FCI)

In the book "The Rise of The Creative Class" Richard Florida (2002) has pointed out to the importance of the creative economy and has presented the concept of Creative Class in an occupational point of view, defined in two major sub-components: Super-Creative Core and Creative Professionals.

Table 4 - Creative Class Occupations

Super-Creative Core occupations	Creative Professionals occupations
Computer and mathematical	Management
Architecture and engineering	Business and financial operations
Life, physical and social science	Legal occupations
Education, training and library	Healthcare practitioners and technical
Arts, design, entertainment, sports and media	High-end sales and sales management

Source: Florida (2002)

He argues that policymakers should focus on a People Climate rather than on a Business Climate, that is, instead of investing on attracting firms and capital, a city should invest on its attractiveness to creative people. According to Florida, the creative class is a key factor in economic development and those cities capable of attracting creative people are more likely to succeed because this class includes those who are more innovative, more entrepreneurial and attract creative enterprises. He explains the geographical distribution of the creative class based on a 3T Model: Talent, Tolerance and Technology.

His Creativity Index is based on those three dimensions and is a synthetic index composed by the sub-indexes of Talent, Tolerance and Technology. The indicators of each sub-index are listed on Table 5.

Table 5 - Creativity Index Components

Talent	Tolerance	Technology
Human Capital	Foreign-born	Innovation
Creative Class	Diversity Index	High-Tech Innovation
Researchers	Gay Index	High-Tech Industry
	Bohemian Index	

Source: Florida (2002)

Florida's work has gained popularity due to its pioneering and radical vision. Also, many times it was considered controversial due to the usage of Gay and Bohemian sub-indexes as drivers of economic development. Although we find the number of dimensions and indicators very limited to effectively assess regions creativity, this

index was taken into account on the construction of the index proposed by this dissertation.

2.2.2. Silicon Valley's Creative Community Index (SV-CCI)

The Creative Community Index stems from a collaborative project between the Knight Foundation, Americans for the Arts, the City of San José Office of Cultural Affairs and Cultural Initiatives Silicon Valley. This project aimed to develop a tool capable of providing an objective source of information about the artistic, creative and cultural life of Silicon Valley (CISV, 2002). The index was built within a conceptual framework based on a causal theory of the impact of creativity on a community:

> *"(…) various "levers" are available for influencing the dynamics of the arts and culture in Silicon Valley. As these **"levers"** are exercised (e.g., a local city government establishes an ordinance to support the acquisition of public works of art), they generate **"assets"** (e.g. sculptures, fountains or murals). These assets, in turn, provide a basis for public **"participation"** in the arts and culture (e.g. enjoying a piece of sculpture in the midst of a shopping district). Finally, the accumulated results of this participation are measurable **"outcomes"**, such as increased feelings of connectedness to neighbours or heightened sense of community identification as a result of living in an aesthetically inspiring environment" (CISV, 2002) .*

According to this guiding framework, the SV-CCI organises its indicators into four categories:

Outcomes: the desired outcomes of a healthy cultural life, broad-based creativity, social connectedness among diverse people and contribution to the quality of life in Silicon Valley.

Participation: residents' participation in arts and cultural activities, including the extent to which diverse people participate together.

Assets: the mix of cultural assets present in the community, including talent in the creative sector (non-profit, public and private), venues and facilities, and the aesthetic quality of our environment.

Levers: the extent to which we leverage and build our cultural assets and encourage people's interaction with them through arts education, leadership, investment, and policies.

Although this project mentions artistic, creative and cultural concepts, the latter was mostly used comprising the first two. For a better and objective comparison between indexes, the "cultural" term mentioned above should be interpreted as "creative" according to the definitions adopted in this dissertation.

2.2.3. Euro-Creativity Index (F-ECI)

A few years later, Florida, in a joint work with Irene Tinagli, tailored his model to fit European reality (Florida and Tinagli, 2004). The main changes were made in the Tolerance sub-index which was built based on a completely different set of indicators with a more subjective nature. Nevertheless, it keeps the main hypothesis of Florida's Creative Capital Theory whose relevance is proven empirically in European regions.

Table 6 - F-ECI dimensions and indicators

Index	Sub-Indexes	Description
Talent	Creative Class	Employed in creative occupations as percentage of total employment.
	Human Capital	Percentage of population 25-64 with a bachelor degree or above.
	Scientific Talent	Number of researchers in scientific disciplines per thousand workforce.
Technology	Innovation Index	Patents applications to the US Patent Office per million population.
	Technology Innovation Index	High-Tech Patents per million population (US Patent Office).
	R&D Index	R&D expenditure as percentage of GDP.
Tolerance	Attitudes Index	Percentage of population that express tolerant attitudes toward minorities.
	Values Index	Degree to which a country is based on traditional values versus more rational/secular values.
	Self Expression Index	Degree to which a country recognises and accepts self expression values.

Source: Florida and Tinagli (2004)

2.2.4. Hong Kong Creativity Index (HKCI)

This index was developed by the Centre for Cultural Policy Research of the University of Hong Kong and commissioned by Home Affairs Bureau, The Hong Kong Special Administrative Region Government. The HKCI was built from the combination of several theories, including the Creative Capital Theory (Florida, 2002), human, social and cultural capital.

The framework behind the HKCI is that any creative act can be analysed by applying the concept of a Cycle of Creative Activity – "creativity is a social process continuously shaped and constrained by the values, norms, practices and structures of "Social Capital", "Cultural Capital" as well as the development of "Human Capital". While the ability to create is embedded in the contexts of three forms of capital, its articulation would be promoted or constrained by the availability and accessibility of facilities, institutions, market and social enablers, or in short the "Structural/Institutional Capital". The accumulated effects and interplay of these different forms of capital are the "Outcomes of Creativity" which could be measured in terms of economic outputs, incentive activities and any other forms of creative goods, services and achievements" (HKSAR, 2004). Therefore, the HKCI framework builds on a 5C's Model.

Table 7 - HKCI dimensions

1	Creativity Outcomes
2	Structural/Institutional Capital
3	Human Capital
4	Social Capital
5	Cultural Capital

Source: (HKSAR, 2004)

The HKCI comprises 88 indicators that are way more than the number of indicators used in Florida's indexes. This option increases the difficulty of collecting data and analysing it but, on the other hand, results in a more complete and effective assessment of a region's creativity and allows to extend the scope of indicators to other important dimensions.

2.2.5. Czech Creativity Index (CZCI)

The CZCI was developed by Kloudova and Stehlikova, in 2007, based on Florida's model and its index dimensions: Talent, Technology and Tolerance. This approach has a peculiarity relevant for this dissertation: their main concern was to analyse the creativity overall and individual scores of Czech regions in terms of regional similarities and geographic location (Kloudova and Stehlikova, 2010). The main conclusions of this study were:

i. Creative regions tend to cluster.
ii. It has been proved that there is a spatial autocorrelation between creative regions, where individual regions affect one another and the neighbouring regions are similar.
iii. The hypothesis about the formation of a creative core or centre in Czech Republic has been rejected.

The hypotheses were only tested in Czech regions but this study has done an interesting analysis on spatial matters.

2.2.6. Composite Index of the Creative Economy (CICE)

The CICE was developed to measure the creative capacity and capability of the Flanders District of Creativity regions (Bowen, Moesen, and Sleuwaegen, 2008). Nevertheless, it was designed to be used in any other region. This index has three key dimensions: Innovation, Entrepreneurship and Openness. These categories are clearly inspired in Florida's theory but the CICE extends the selected indicators to new aspects such as business activity and ICT infrastructure.

This index stands out from the others by proposing an innovative method to determine the weight that each indicator has on the index global value. Normally, in order to ease the index calculation, it is adopted a simple aggregation procedure, which consists of assigning equal weights to each indicator. In many cases, this may give a wrong perception that each indicator has the same importance when it is not true. Unequal weights can be determined, based on the opinion of experts, but, this is an expensive

procedure, not to mention that it is a subjective judgement and, as such, will probably result in several divergent opinions, raising a new problem: which expert opinion is more correct? The methodology proposed by the CICE – endogenous weighting[4] – selects the set of weights that maximise the index value for each region. A good performance in a particular dimension can reveal that it should be given a higher priority and each region will have its own set of weights. The CICE methodology will be explained and demonstrated in Section 4.1.

2.2.7. Creative City Index (J-CCI)

This index was developed by the Fukuoka Benchmarking Consortium in the context of an International Regions Benchmarking Consortium conference in 2008. It integrated a study comparing six major Japanese cities in terms of creativity. The main hypothesis of the study is that a high score in the J-CCI would attract the Creative Class and would develop Knowledge Society (Consortium, 2008).

The approach taken on the construction of this index is noteworthy due to the classification of the used indicators. The index comprises seventy-eight indicators which are separated into two main categories: fundamental and flow factors. This differentiation may be useful for an evolutionary analysis of a creative city.

Table 8 - J-CCI categories and dimensions

Fundamental Factors	Flow Factors
Industrial Infrastructure and Human Resources	Flow of people
Research and Tertiary Education	Flow of materials
Convenience, Culture and Entertainment	Flow of money
Living Environment	Flow of information
Exchange Activities	Flow across national boundaries

Source: (Consortium, 2008)

[4] Inspired by data envelopment analysis (DEA) as developed by Charnes, Cooper and Rhodes (1978) in the context of operations research, in order to aggregate either inputs or outputs into a meaningful index of productive efficiency.

2.2.8. European Creativity Index (ECI)

This index was developed by KEA European Affairs as part of a study conducted for the European Commission (Affairs, 2009). The purpose of this study was to extend the indicators of existing indexes to a dimension specifically related to arts and culture. This index comprises thirty-two indicators organised in six pillars.

Table 9 - ECI Dimensions

1	Human Capital
2	Openness and Diversity
3	Cultural Environment
4	Technology
5	Institutional Environment
6	Creative Outputs

Source: (Affairs, 2009)

The methodology used in the construction of the ECI will be very useful for our own proposal of index because it was developed thinking in the European context which is the one that is going to be analysed by us.

2.2.9. Baltimore Creativity Index (BCI)

Acs and Megyesi (2009) tailored Florida's model in order to assess the potential of transforming Baltimore, a traditionally industrial region, into a creative region. Although BCI is essentially identical to FCI, the small changes that were implemented into it are particularly relevant to this dissertation because they place the economic space matters into the analysis. On the one hand, a fourth dimension is included in the index: Territory. It accounts for territorial and communal amenities, also focusing on Wage Inequality Index and Housing Inaffordability Index. On the other hand, the study points out to the importance of Baltimore's geographical proximity to Washington, DC – a recognised creative and high-tech epicentre. The proximity problem assumes that cities' interaction has impact in terms of creativity. This hypothesis will be analysed in a further chapter dedicated to spatial matters.

2.2.10. Landry's Creative City Index (L-CCI)

In 2009, in collaboration with Bilbao and the Bizkaia region, Charles Landry and his colleague Jonathan Hyams have developed the Creative City Index (Landry, 2010). This index was created to assess and measure the imaginative pulse of cities and uses three elements – an internal assessment, an external assessment and a web based survey[5].
Very few details have been released to the public about the indicators and metrics used. On his website[6], Landry only identifies ten dimensions that characterise a creative place and each dimension is constituted by "key indicators of creativity, resilience and the capacity to future proof a city".

Table 10 - L-CCI Dimensions

1	Political and public framework
2	Distinctiveness, diversity, vitality and expression
3	Openness, trust, tolerance and accessibility
4	Entrepreneurship, exploration and innovation
5	Strategic leadership, agility and vision
6	Talent and the learning landscape
7	Communication, connectivity and networking
8	The place and placemaking
9	Liveability and well-being
10	Professionalism and effectiveness

Source: (Landry, 2010)

2.2.11. Creative City Index (CCI-CCI)

This index was conducted for the Beijing Research Centre for Science of Science (BJSS), Beijing Academy of Science and Technology (BJAST). The CCI-CCI was prepared by five researchers of ARC Centre of Excellence in Creative Industries and Innovation (ARC-CCI, 2012), including John Hartley and Jason Potts - renowned specialists in creative economics. It is the most recent international study on creative

[5] The survey can be completed at www.creativecityindex.org.
[6] www.charleslandry.com/index.php?l=creativecityindex.

indexes and by far the most complete review of the City Indexes Industry. The CCI-CCI comprises seventy-two indicators grouped in eight dimensions.

Table 11 - CCI-CCI dimensions

1	Creative industries scale and scope
2	Microproductivity
3	Attractions and economy of attention
4	Participation and expenditure
5	Public support
6	Human capital
7	Global integration
8	Openness, tolerance and diversity

Source: ARC-CCI (2012)

The first three dimensions are novel inclusions in indexes. The CCI-CCI was tested on six cities from the United Kingdom, Australia and Germany – one metropolitan city and one provincial city of each country. In the future, the BJSS will collect data and compile the CCI-CCI for Beijing and other cities inside China for benchmarking.

2.3. Indexes comparison

The eleven indexes reviewed are quite different as regards the number and type of indicators, the included dimensions, the underlying theoretical framework and the adopted methodology. Table 12 presents a checklist of the indicators covered by the indexes, organised in ten dimensions which we take as key creative aspects and which comprise all the indicators. These ten dimensions will also serve as a basis for the construction of our own index.

By looking at the table it becomes clear that three dimensions are considered mandatory for building a creativity index: "Human Capital, Creative Class and Education", "Openness, Diversity and Tolerance" and Technology and Innovation". However, we think they are insufficient to address such a complex concept as creativity and its economic impact. In our point of view, an optimum index must include all ten dimensions. Some can be more or less important than the rest, but that can be overcomed by adjusting the weigthing based on statistical evidence or on the opinion of experts. The absence of one or more dimensions may bias the decisions of policymakers.

Table 12 - Checklist of Indexes Dimensions and Indicators

Dimensions \ Indexes	1. FCI	2. SV-CCI	3. F-ECI	4. HKCI	5. CZCI	6. CICE	7. J-CCI	8. ECI	9. BCI	10. L-CCI	11. CCI-CCI
1 Human Capital, Creative Class and Education	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2 Openness / Diversity / Tolerance	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
3 Cultural Environment and Tourism		✓		✓			✓	✓		✓	✓
4 Technology and Innovation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5 Regulations and Financial Policies		✓		✓				✓		✓	✓
6 Employment, Outputs and Outcomes		✓		✓				✓			✓
7 Entrepreneurship		✓		✓		✓	✓			✓	
8 Infrastructures				✓						✓	✓
9 Liveability and Amenities						✓			✓	✓	✓
10 Branding and Notoriety		✓								✓	✓
Number of Indicators	9	11	9	88	6	8	78	32	9	?	72

Source: Author

Table 13 highlights the indexes strengths and weaknesses that are relevant for this dissertation. We are not trying to determine which is the best index because all of them are important and useful for a particular purpose. We will use the positive aspects as inspiration for our index, and we will seek to identify the gaps to fill and the weaknesses to amend.

Table 13 - Indexes strengths and weaknesses

Index	Strengths	Weaknesses
1. FCI	One of the most popular, successful and discussed indexes with high acceptance by policymakers. Put focus on "People cimate" instead of "business climate".	Too broad definition of creativity, including industries and occupations beyond the so-called creative. Limited number of dimensions to assess such a complex phenomenon as creativity.
2. SV-CCI	Emphasises the importance of culture for creativity, technological progress and social connectedness.	Built on personal interviews and surveys what makes it very specific to Silicon Valley and difficult to use in other regions.
3. F-ECI	The first rank of european countries.	Only 14 european countries analysed. Same weaknesses of FCI.
4. HKCI	Comprises 88 indicators which make the index more complete and effective.	The large number of indicators also increases the difficulty of collecting data and analysing it.
5. CZCI	Introduces spatial matters into the analysis by testing the index scores for clustering and spatial autocorrelation.	Only tested in Czech Republic regions. Same weaknesses of FCI.
6. CICE	Proposes an innovative method to determine weights: endogenous weighting	Reduced number of dimensions and indicators.
7. J-CCI	Differentiation between Fundamental and Flow factors, focused on the analysis of cities evolution over time.	Does not provide info about methodology and metrics.
8. ECI	Very good set of dimensions and a proper number of indicators. It specifies the data sources.	Not tested empirically. Data sources only at country level.
9. BCI	Spatial dimension added to the analysis through territorial amenities and the study of proximity impact on creativity.	Only analyses Baltimore and its proximity to Washington, D.C..
10. L-CCI	Ten dimensions well explained with an efficient coverage of creativity. Uses both an internal and an external assessment and a web based survey.	Methodology and metrics not revealed to public.
11. CCI-CCI	Gathers the best of all previous indexes and presents some new indicators.	Ignores an important dimension: Entrepreneurship.

Source: Author

2.4. Conclusions of the indexes review

Although creativity indexes only started being developed in the last decade, there is already a considerable number of indexes created to measure creativity at country, regional and city level. We only reviewed eleven we consider the most important and the most relevant for this dissertation, but there are a few others.

Much has been done since Florida presented the first one in 2002. New frameworks have been assumed, different methodologies were adopted and many dimensions and respective indicators have been proposed to better assess creative performances. Other indexes were mere adaptations of Florida's work to a particular region's reality. The SV-CCI has emphasised the importance of culture. The CICE has presented the innovative endogenous weigthing method. The J-CCI has enabled a better analysis in an evolutionary perspective by separating flow and stock indicators. The CZCI and the BCI highlighted some spatial aspects of creativity. The latest index created, the CCI-CCI, is, in our point of view, the most complete and developed one. It stems from the lessons learned from the past, gathering the best from the existing indexes. However, it also has a few gaps that we will seek to fill such as not including an entrepreneurship dimension and the fact that some of its indicators data does not have a commom source. This forces to collect data from different sources which makes the process more difficult and also compromises the comparability of the results.

3. A PROPOSAL OF A CREATIVITY INDEX

An index can be a great tool to stimulate dialogue about the importance of creativity as well as to improve policymaking. There are already many indexes; however, we think they have weaknesses that need to be fixed. Therefore, we propose a new index seeking to fill the existing gaps. Due to the nature of this dissertation we called it Creative Space Index (CSI). Inspired by the lessons learned from the past, it aims to be a superior index by gathering the best aspects of the existing ones and complementing them with additional features. The index was developed according to the following principles:

- **Universal** – it should be able to analyse different realities and to enable comparisons across the globe.
- **Flexible** – it should be adaptable to work with different scopes – country level, regional level and city level – and with different data sources.
- **Efficient** – it should cover as many aspects as possible of the creative phenomenon, keeping the data collection easy and simple.
- **Unbiased** – creativity does not depend on a single dimension and it is important for the index to be wide ranging and properly weighted for a better policymaking.

3.1. Theory

There is no unique recipe of a creative country, region or city. It is not something entirely plannable and controllable because there is a lot of informality and spontaneity involved in the creative process. Each place has to find its own particularities and its mission is to potentiate the existing resources. A good creativity index should reveal what a region is doing well or wrong, so it can optimise its policies and decisions.

Measuring creativity, both at the individual and at the collective perspective, is not an easy task due to its complex nature. There is neither an established framework nor a generally accepted methodology. We decided that the best way to design a solid index

was to define its dimensions based on the categories used to group indicators in the indexes comparison because they are in conformity with the principles stated above and cover all relevant aspects of creativity.

D1. Talent

A creative place should nurture, foster, promote and reward all talents (Landry, 2010). It is a place that offers a wide range of learning options, enabling people to find their right vocation. These are provided by institutions such as universities as well as by a more informal interaction between individuals, organisations and places. Economists agree that skilled and educated people, normally referred as human capital, play a role in economic progress. The Creative Class has an equally important role as well (Florida, 2002).

D2. Openness

A creative place should be open minded and tolerant in order to welcome people with different backgrounds and cultures (Florida, 2002; Landry, 2010). An environment of diversity increases the generation and the flow of ideas. It eases the interaction communication and it attracts talent.

D3. Cultural Environment and Tourism

Cultural life is a key element in a region's quality of life and the participation in cultural activities increases people connections to each other and to place (CISV, 2002). So, the cultural offering must include a variety of experiences and ways for the community to express itself. Tourism is the best way to promote and potentiate the cultural assets that a region has to offer and culture is what most motivates tourists to visit a specific place.

D4. Technology and Innovation

Technology and innovation simultaneously foster and depend on creativity. People's creativity is the motor of technological progress and innovation (CISV, 2002, Florida, 2002; HKSAR, 2004; Landry, 2010). The latter are the indicators of how well is taken advantage of the first.

D5. Industry

A high share of creative industries is a good indicator of good creative performance. However, a region should also have a diversified business structure with international reach in order to maximise positive externalities and spillovers.

D6. Regulation and Incentives

Both creative individuals and businesses play an important role, but they need a favourable environment to create. A place should ensure good conditions for creativity to develop, whether with public support or with a fair regulatory system (CISV, 2002).

D7. Entrepreneurship

Without entrepreneurship, creativity is not likely to lead to economic growth as ideas are not translated to the market. On the other hand, the economic success of a creative individual or organisation depends very much on the level of easiness of doing business combined with the financial resources available.

D8. Accessibility

A creative place is well connected internally and externally (Landry, 2010). So, it should have a good transport system and infrastructure. Proximity to other creative regions increases the creative potential of the place, but only if it is accessible.

D9. Liveability

A region should be able not only to attract creative talent but also retaining it (Florida, 2002). Therefore, a creative place must have a good quality of life and should offer local amenities that make it a place where people like to live and work.

D10. Notoriety

A creative place should be distinct and have a clear identity (Landry, 2010). It can result either from historical and natural reasons or from the dynamism of its culture. Now more than ever, it is usual to see creativity being used for territorial marketing purposes.

3.2. The Creative Space Index

The CSI comprises a wide variety of quantitative and qualitative indicators to estimate creative performance at country, region and city level. In order to capture different aspects of creativity, the indicators are grouped into dimensions as explained in Table 14. Creativity is a complex concept and, therefore, in order to build an index that addresses its characteristics as efficiently and logically as possible, each dimension is composed by indicators that, if applicable, measure both inputs and outputs, both demand and supply, both investments and results, both hard and soft characteristics, both people and business climate, both stock and flow factors.

Table 14 – European CSI - Dimensions, Indicators and Description

Dimension	Indicator	Description
D1 - Talent	Human capital	Nr of graduates per capita
	Creative class	Nr of persons in creative occupations per capita
	Education	Nr of universities in THEWUR per million inhabitants
D2 - Openness	Diversity	Share of non-nationals among residents
	Discrimination	FRA's multiple discrimination index
	Foreign talent	Share of tertiary foreign students
D3 - Cultural Environment and Tourism	Cultural offering	Nr of museums and cinemas per million inhabitants
	Cultural participation	Nr of visitors per museum
	Cultural values	Degree of personal importance of culture
	Cultural expend.	Share of household expenditure on culture
	Tourism capacity	Nr of bed-places per capita
	Tourism occupancy	Tourism establishments occupancy rate
D4 - Technology and Innovation	R&D	R&D expenditure as percentage of GDP
	HRST	Percentage of human resources in science and technology
	Internet access	Share of households with internet access at home
	Patents	Nr of patents registered per million of inhabitants
D5 - Industry	Creative industries	Nr of creative enterprises per capita
	Creative employment	Share of employment in creative industries
	Creative diversity	Shannon's diversity index
	Internationalisation	Exportation of cultural goods
	Value added	VA of creative industries as percentage of GDP
	Turnover	Turnover in creative industries per capita

Dimension	Indicator	Description
D6 – Regulation and Incentives	Public incentive	Direct public expenditure on culture per capita
	Royalties	Author's Royalties Collected per capita
	Property rights	Score in the International Property Rights Index
D7 - Entrepreneurship	Startups	Newly established enterprises per 1000 inhab.
	Venture capital	Venture capital per capita
	Business angels	Business Angels funding per capita
	Beasiness	Level of easiness of starting a business
D8 - Accessibility	Air	Nr of airports per capita
	Road	Length of motorway per area
	Rail	Length of railway per area
D9 - Liveability	Purchase power	National price level indices (EU27=100)
	Crime	Nr of recorded crimes per thousand
	Health Care	Nr of health care facilities per capita
	Leisure and recreation	Share of land in recreational and leisure use
	Well-being	Experienced well-being score in Happy Planet Index
D10 - Notoriety	Capitals of culture	Nr of UNESCO capitals of culture
	World Heritage	Nr of buildings in UNESCO Wordl Heritage list
	Gastronomy	Nr of Michelin stars per capita

Source: Author

The main data source is Eurostat providing 75% of the indicators data (30/40 at country level). For the remaining indicators data is obtained from World Bank, International Labour Organization, European Group of Museum Statistics, KEA European Affairs, International Confederation of Societies of Authors and Composers, among others. Data is not always available for all countries neither is it always referring to the same year for all elements. So, the selection procedure involves getting data of the most recent year available and when the data from the main common source is missing for some country it is obtained from the relevant national institutes or organisations. If there is still no data available, the remaining values are imputed using the immediately above hierarchical level, e.g, if the index is being estimated at city level and there is missing data for any element, the value is imputed using the value of the NUTSIII region to

which it belongs. The same happens for NUTSIII regions, this time using values from NUTSII.

In order to remove the scale effect from the index and to make the scores directly comparable between all elements, when necessary, the indicators were relativised using auxiliary indicators such as Population, GDP and Area. The type of number and the nature of each indicator are well explained in its description.

A structure analysis has been done aiming to study the overall structure of the index and to check if there are any indicators that are statistically similar, i.e, that provide the same information and, therefore, at least one is redundant. Using a correlation matrix of all indicators we have checked that all of them are relevant and their presence in the index is advantageous. Only a few indicators presented high values of correlation: Air, Road and Rail, used to measure the dimension Accessibility, are highly correlated but all of them are important otherwise the exclusion of any of them would bias the analysis.

For all indicators data is transformed using the Min-Max normalisation method. This process transforms data from its original units to a value between 0 and 1. The normalised value for country, region or city *i* is defined as:

$$N_i = \frac{X_i - MIN(\forall_i X_i)}{MAX(\forall_i X_i) - MIN(\forall_i X_i)} \tag{3.1}$$

The maximum normalised score is equal to 1 and the minimum normalised score is equal to 0.

In all composite indicators, aggregation is an important step of their construction and should not be taken lightly. Any modification in the weightings will change the overall score of the index and, consequently, the rankings. Normally, in order to ease the indexes calculation, it is adopted a simple aggregation method which consists of assigning equal weights to each dimension. This may give the wrong perception that each dimension has the same importance, which may not be true. Unequal weights can be determined based on the opinion of experts, but, this is an expensive procedure, not

to mention that is a subjective judgement and, as such, probably will result in several divergent opinions. In CSI we first use equal weights and then we also apply an endogenous weighting technique which will be explained in section 1 of chapter 4.

3.3. Why space matters?

Spatial economics was left out of mainstream economics during most of the twentieth century. The fact that it has produced only literary ideas and has been followed by almost no mathematisation, added to the fact that it was mostly discussed in German, explains why spatial theories and models were overlooked by the Anglo-Saxon mainstream. In the end of the twentieth century the spatial economics has gained higher significance with the arising of a new line of theory - New Economic Geography (NEG). The globalisation increased the importance of a spatial perspective in the analysis of the economic phenomena with the growth of international trade and migration, the opening up of markets, the emergence of regional blocks and the impact on world political strategies. The NEG provided a new set of tools for spatial analysis.

Economists have resisted the analysis of creativity under a spatial perspective because the creative process is usually more heterogeneous and complex when compared to the rest of the economic goods and activities. Most of the literature is focused on clustering theories since it is the most visible phenomenon. It is commonly accepted that creative businesses and people tend to cluster due to economies of scale and positive externalities, but little has been done on other spatial aspects. We will try to fill this gap by addressing the relationship between some key spatial characteristics and creativity based on the results of our index.

3.3.1. Spatial approaches of existing indexes

After a thorough search we find only a couple of studies that have already approached creativity indexes in a spatial perspective which, by this reason, where included in the literature review, namely BCI and CZCI.

Acs and Megyesi (2009) presented a case study of Baltimore and they refer to spatial matters by two separate ways. On the one hand, by adding Territory as a new dimension to Florida's index. The underlying theory is that a city with territorial amenities will attract creative talent. This could be infrastructures, higher wages and house affordability, among others. On the other hand, they say that Baltimore has a huge creative potential due to its proximity with Washington, DC which is a recognised creative core and considered the largest reservoir of creative talent in the USA. The creative performance of Baltimore might be highly dependent on the region's ability to absorb the talent from the surrounding area. The matter of proximity seems to be extremely important to study creativity and we will address it in a further chapter.

Kloudova (2010) searched for spatial similarities in the results of CZCI. First, the author tested czech regions for cluster formation and concluded that creativity tends to cluster, with Prague isolated as the biggest one. Second, the author proceeded with a spatial autocorrelation analysis, proving that a region affects the surrounding area and that neighbouring regions are more similar in terms of creativity than those more distant. Again, proximity raises interest in researchers. Third, the author tested the hypothesis of concentration into creative centres also known as creative cores, which has not been confirmed.

3.3.2. The CSI spatial framework

The assessment of spatial matters by the CSI is twofold. In section 4 of chapter 4 we will analyse how the CSI results relate to a region's spatial structure. On the other hand, some CSI indicators were selected according to an underpinning spatial theory inspired in gravity models. Every place can be creative in its own way, but it has necessarily to be attractive and interactive. To be attractive it must have an open minded and tolerant community, a diverse cultural offering, amenities that make it a desirable place to live and a distinctive identity. To be interactive it must reduce the distance decay effect by investing in its accessibility, either physical or virtual. The CSI spatial framework and its respective indicators are presented in Figure 3.

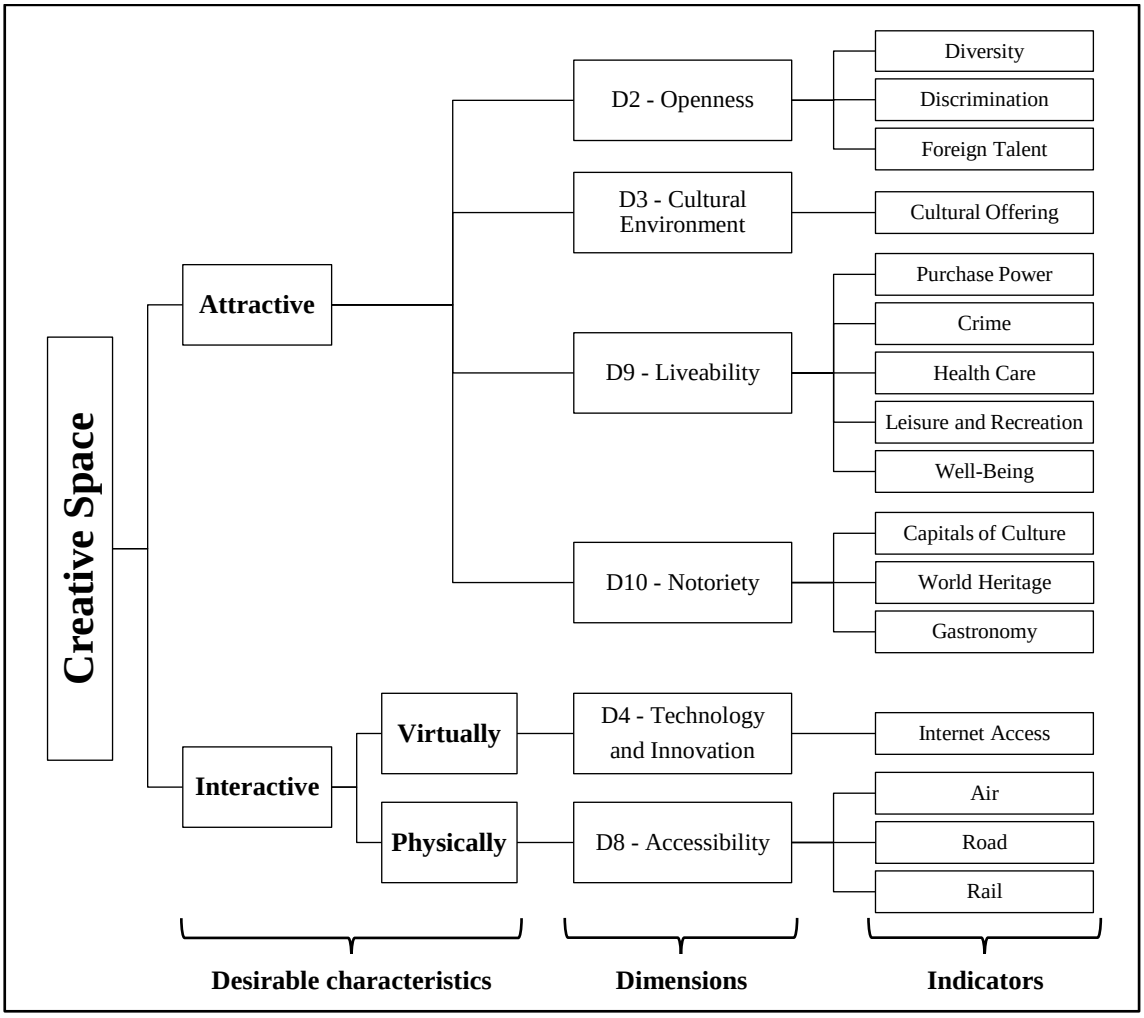

Figure 3 - CSI spatial framework

4. CSI EMPIRICAL APPLICATION: EU MEMBER STATES

We used the CSI to assess EU-27 states creativity, with the exception of Malta due to the lack of available data. Table 15 ranks the European countries on the CSI. It presents the unweighted results of countries overall score in creativity and their performance on each dimension.

Table 15 - European Creative Space Index

Country	Rank	Score	Dimensions									
			D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Netherlands	1	5.36	0.51	0.34	0.55	0.73	0.46	0.72	0.64	0.46	0.62	0.34
France	2	5.28	0.40	0.37	0.60	0.55	0.39	0.68	0.57	0.29	0.50	0.93
United Kingdom	3	5.26	0.78	0.35	0.55	0.55	0.57	0.52	0.59	0.34	0.44	0.56
Germany	4	5.14	0.59	0.18	0.56	0.74	0.47	0.55	0.37	0.39	0.57	0.73
Denmark	5	5.00	0.47	0.34	0.59	0.79	0.45	0.95	0.44	0.37	0.43	0.17
Sweden	6	5.00	0.52	0.34	0.49	0.90	0.45	0.72	0.76	0.33	0.26	0.24
Finland	7	4.87	0.54	0.11	0.51	0.90	0.38	0.69	0.66	0.25	0.53	0.28
Belgium	8	4.78	0.37	0.36	0.42	0.57	0.34	0.78	0.34	0.67	0.48	0.47
Luxembourg	9	4.57	0.13	0.76	0.25	0.82	0.28	0.61	0.28	0.73	0.47	0.24
Austria	10	4.14	0.23	0.33	0.44	0.58	0.33	0.76	0.29	0.30	0.57	0.31
Ireland	11	3.91	0.52	0.22	0.46	0.53	0.38	0.35	0.40	0.25	0.54	0.25
Spain	12	3.86	0.35	0.29	0.51	0.30	0.33	0.37	0.32	0.30	0.37	0.73
Italy	13	3.51	0.24	0.36	0.45	0.28	0.33	0.27	0.11	0.30	0.40	0.76
Czech Republic	14	3.36	0.24	0.12	0.53	0.31	0.41	0.22	0.33	0.39	0.61	0.21
Portugal	15	3.15	0.15	0.24	0.35	0.15	0.30	0.27	0.63	0.28	0.35	0.43
Slovenia	16	3.08	0.10	0.13	0.46	0.41	0.43	0.24	0.30	0.42	0.49	0.11
Estonia	17	3.07	0.35	0.04	0.55	0.40	0.28	0.25	0.31	0.18	0.58	0.13
Hungary	18	2.91	0.13	0.24	0.48	0.23	0.38	0.23	0.27	0.23	0.55	0.17
Cyprus	19	2.84	0.13	0.36	0.43	0.23	0.29	0.27	0.17	0.48	0.46	0.02
Poland	20	2.51	0.19	0.05	0.47	0.23	0.26	0.14	0.12	0.23	0.60	0.21
Slovakia	21	2.51	0.35	0.13	0.26	0.22	0.15	0.12	0.33	0.20	0.60	0.14
Greece	22	2.47	0.13	0.29	0.25	0.11	0.25	0.13	0.11	0.29	0.44	0.48
Latvia	23	2.15	0.15	0.11	0.36	0.22	0.18	0.11	0.37	0.10	0.53	0.02
Lithuania	24	2.05	0.10	0.00	0.26	0.26	0.13	0.10	0.31	0.15	0.60	0.14
Bulgaria	25	1.66	0.11	0.05	0.11	0.07	0.32	0.01	0.26	0.15	0.53	0.06
Romania	26	1.51	0.05	0.07	0.20	0.01	0.19	0.01	0.11	0.16	0.56	0.16

There is not an isolated leader and only six countries score higher than 5.00. The CSI is higher in the Netherlands, followed by France, the United Kingdom, Germany, Denmark and Sweden. The lower scores, and the only ones below 2.00, are from Bulgaria and Romania. The CSI scores vary from 1.51 and 5.36 which indicates that even the Netherlands, ranked first, is almost half the distance to the perfect score of 10. This shows how much remains to be achieved in terms of creativity.

Figure 4 depicts the geographical distribution of creativity in Europe. It makes clear the heterogeneity of the CSI results and the concentration of higher scores in Central Europe, which decrease as we move to the peripheral countries. A country's proximity to creative cores appears to highly influence its creative potential.

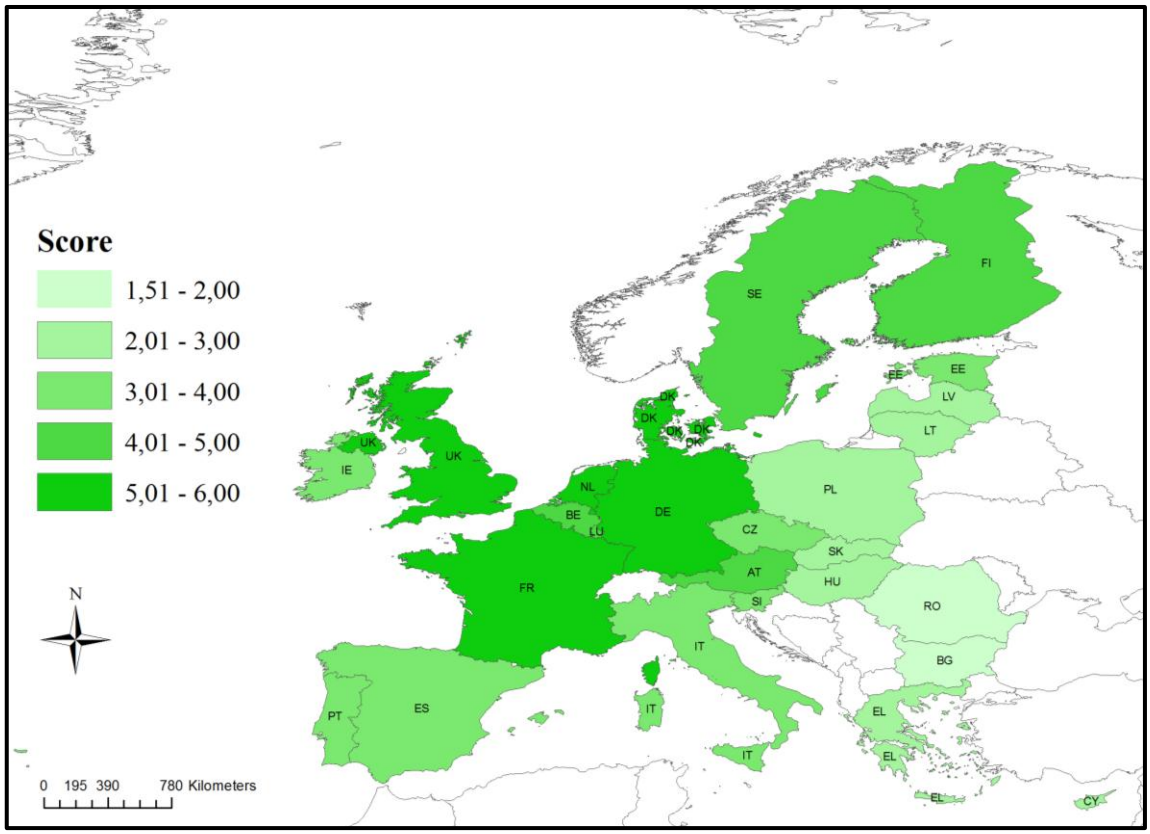

Figure 4 - Creative Space Index in EU member states

The Figure 5 shows that there is not a unique recipe for reaching higher creativity scores. But it reveals a pattern in which the top 6 countries have relatively higher and lower scores in the same dimensions, except dimension D10 (Notoriety) in which scores vary from 0.17 to 0.93, respectively Denmark and France.

Among the top 6 countries, the dimensions with a higher average score are D4 (Technology and Innovation) and D6 (Regulation and Incentives). The dimensions with lower average scores are D2 (Openness) and D8 (Accessibility).

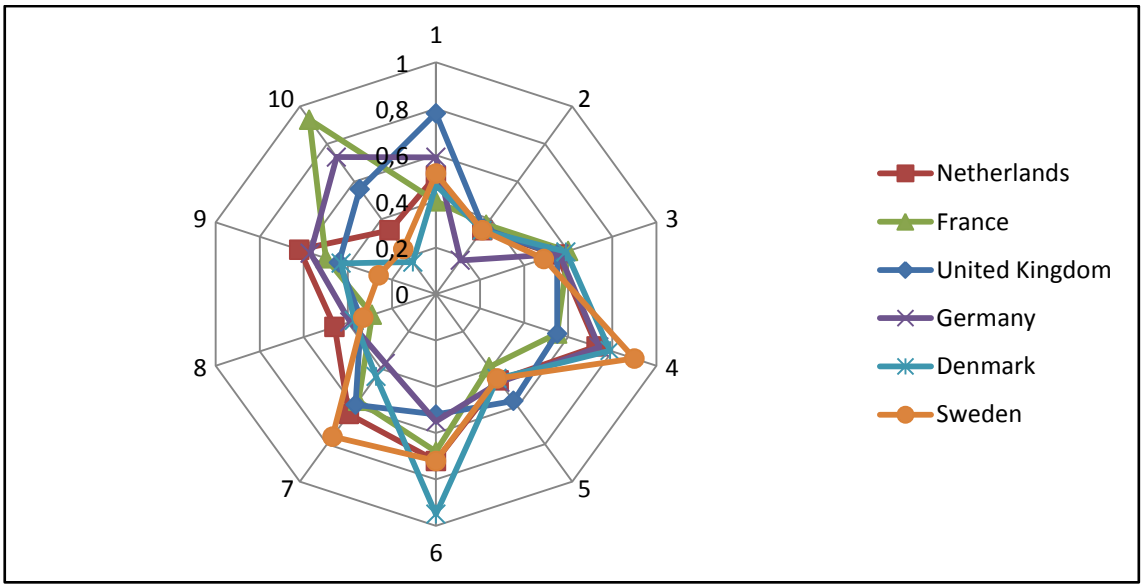

Figure 5 - Top 6 CSI scores by dimension

4.1. CSI with endogenous weigthing

In our index we first used equal weights and now we are going to apply an endogenous weighting technique which was first advocated by Melyn and Moesen in 1991 for the purpose of constructing a composite index of macroeconomic performance and then adapted to creativity indexes by Bowen *et al*. (2008). The endogenous weighting methodology selects the set of weights that maximise the index value for each region. Thus, each region will have its own set of weights and a good performance in a particular dimension can reveal that it should be given a higher priority.

Given *n* regions and *J* dimensions, the linear programming problem for region *i* can be written

$$\max CSI_i = \max_{w_{ij}} \sum_{j=1}^{j} w_{ij} D_{ij} \tag{4.1}$$

subject to

$$\sum_{j=1}^{j} w_{ij} = 1 \qquad \forall i = 1,...,n \tag{4.2}$$

$$\frac{1}{13} \leq w_{ij} \leq \frac{3}{13} \qquad \forall i = 1,...,n; \qquad \forall j = 1,...,J \tag{4.3}$$

Expression (4.1) states that region *i*'s CSI value is to be maximised by choice of the w_{ij}. Restriction (4.2) requires that the weights assigned to each dimension D_{ij} sum to one; this restriction is minimal and allows flexibility in determining the optimal weights for a region. Expression (4.3) restricts the value each weight can take to a particular interval. This restriction, in practice, assigns the dimension with the best score with a 3/13 weight, the second best dimension with a 2/13 weight and the rest of the dimensions with 1/13. This way all dimensions have a 1/13 weight, except the best and the second best dimensions which weigh three and two times more, respectively. We have changed the original model weight boundaries to better suit the higher number of dimensions.

Table 16 shows the scores and ranking of the CSI with and without endogenous weights. One can see that only 11 out of 26 countries have their rank affected. The biggest changes occurred in Denmark, Sweden, Germany and the Netherlands. While the first two climbed three positions, the last two slipped down the ranking three positions. This is justified by the fact that endogenous weights favours countries which are stronger in two or three dimensions and disfavours countries which have similar scores in all dimensions.

Table 16 - Comparison of CSI with and without endogenous weigthing

	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	IT	CY	LV	LT	LU	HU	NL	AT	PL	PT	RO	SI	SK	FI	SE	UK
A	4.8	1.7	3.4	5.0	5.1	3.1	3.9	2.5	3.9	5.3	3.5	2.8	2.1	2.1	4.6	2.9	5.4	4.1	2.5	3.1	1.5	3.1	2.5	4.9	5.0	5.3
RA	8	25	14	5	4	17	11	22	12	2	13	19	23	24	9	18	1	10	20	15	26	16	21	7	6	3
B	5.4	2.3	3.9	5.9	5.7	3.7	4.2	3.0	4.5	6.0	4.2	3.3	2.8	2.7	5.4	3.4	5.8	4.8	3.2	3.7	2.2	3.5	3.1	5.7	5.8	5.7
RB	8	25	14	2	7	16	12	22	11	1	13	19	23	24	9	18	4	10	20	15	26	17	21	6	3	5
Dif.	0	0	0	3	-3	1	-1	0	1	1	0	0	0	0	0	0	-3	0	0	0	0	-1	0	1	3	-2

Legend: *A – CSI with equal weights; B – CSI with endogenous weights; RA – Rank A; RB – Rank B.*

4.2. CSI and Florida's Euro-Creativity Index

We wanted to compare the results of the CSI with other indexes. The only one that has assessed creativity in European countries was Floridas' Euro-Creativity Index which covers 14 countries. By looking at Table 17, more specifically at Comparison A, one can see that there is a great difference between the two indexes' results as 10 out of 14 have their rank changed and, when compared to F-ECI, France climbs 6 places in CSI while Finland and Sweden descend 5 places. This difference could be caused by the indicators used or by the seven new dimensions of the CSI. So, we calculated the CSI as it was composed only by Dimensions 1,2 and 4 which are equivalent to ECI's sub-indexes. Comparison B shows that the difference between CSI and F-ECI results exist both with all dimensions or only with D1, D2 and D4. Only Spain and Italy have the same rank in all three indexes, therefore, one may conclude that the new dimensions included in CSI are relevant and affect the creativity overall scores and ranking.

Table 17 - Comparison between CSI and F-ECI

Country	BE	DK	DE	IE	EL	ES	FR	IT	NL	AT	PT	FI	SE	UK
CSI Score	4.78	5.00	5.14	3.91	2.47	3.86	5.28	3.51	5.36	4.14	3.15	4.87	5.00	5.26
CSI Rank	8	5	4	10	14	11	2	12	1	9	13	7	6	3
F-ECI Rank	6	4	5	10	13	11	8	12	3	9	14	2	1	7
Comparison A	-2	-1	1	0	-1	0	6	0	2	0	1	-5	-5	4
Score (D1,D2,D4)	4.30	5.34	5.03	4.24	1.74	3.14	4.38	2.93	5.29	3.79	1.80	5.19	5.85	5.60
Rank (D1,D2,D4)	8	3	6	9	14	11	7	12	4	10	13	5	1	2
Comparison B	-2	1	-1	1	-1	0	1	0	-1	-1	1	.3	0	5

4.3. Creativity and Economic Performance

Many studies have emphasised the importance of creativity to economic growth and development (e.g., Florida, 2002; UNCTAD, 2010). The CSI results are consistent with that idea. By looking at Figure 6, one can clearly see that creativity and GDP per capita have a positive correlation which is statistically significant at the 0.01 level. This means that countries showing better economic performance also show higher CSI scores, however one may not conclude if higher creativity is a cause or a consequence of higher GDP, and vice versa. There is an isolated point which refers to Luxemburg that has a much higher GDP per capita when compared, not only with countries with similar CSI score, but also with all the EU member states.

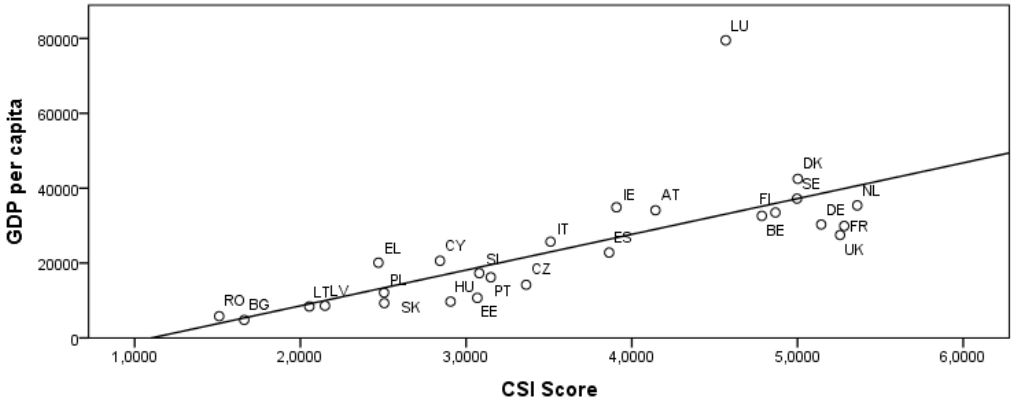

Figure 6 - Correlation between creativity and GDP per capita

4.4. Creativity and space

While some authors argue that distance is no longer important in a globalised world, others advocate that location is still a crucial factor. Does it matter for creativity? History showed that creative people and businesses tend to cluster which has also been proved empirically (Lazzeretti, 2008; NESTA, 2010). But little has been done about other spatial aspects.

One of the main goals of this dissertation is to study the relationship between creativity and economic space. We selected some key aspects that characterise countries' dimension and spatial structure, and analysed how they relate to creativity.

4.4.1. Scale

By looking at Figure 7 it makes clear that there is not a minimum size required to be a creative leader. The Netherlands has about one third of the population size of the other two countries that share the CSI podium. There is a small correlation between creativity and the population size of the EU-27 countries, however it is not statistically significant.

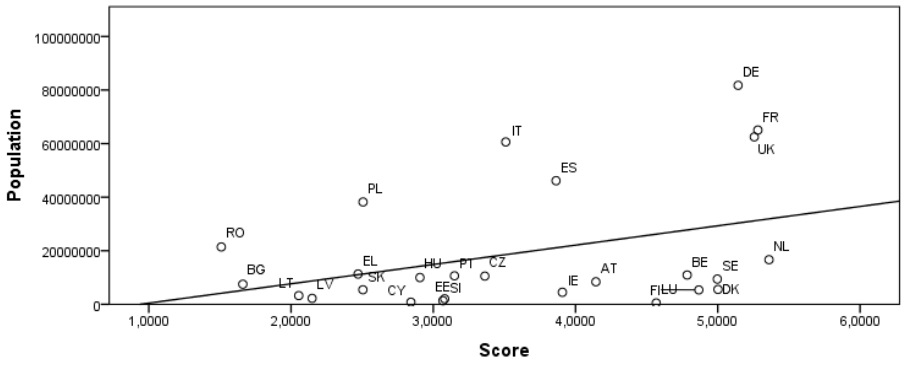

Figure 7 - Correlation between creativity and population

4.4.2. Density

The geographic concentration of people powers the interaction, exchange and spillovers that are crucial to creativity. Figure 8 supports this idea showing a positive correlation between creativity and population density which is statistically significant at the 0.05 level. Although not visible in EU-27 countries, it is expectable that there is a limit beyond which population density will be negatively related with creativity due to the negative effects of overpopulated areas.

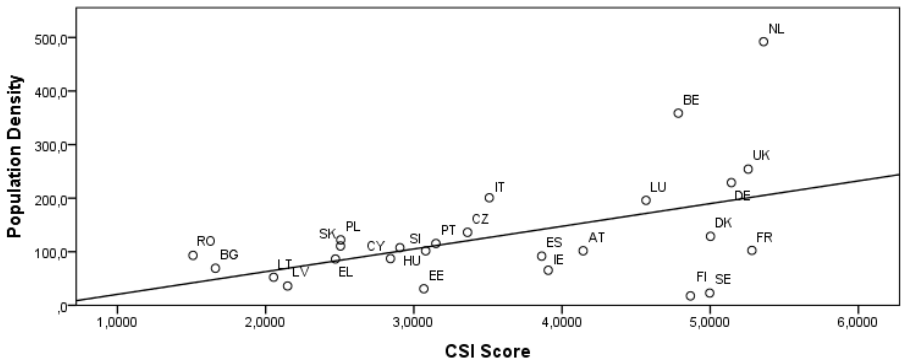

Figure 8 - Correlation between creativity and density

4.4.3. Urban Hierarchy

We questioned if a country's creative performance is related to the position of its cities in European urban hierarchy. We rated cities between 1 and 12 according to GaWC typology[7] and then we summed the scores for each country. The results presented in Figure 9 reveal a positive correlation statistically significant at the 0.01 level, between creativity and how well countries' cities rank in the urban hierarchy.

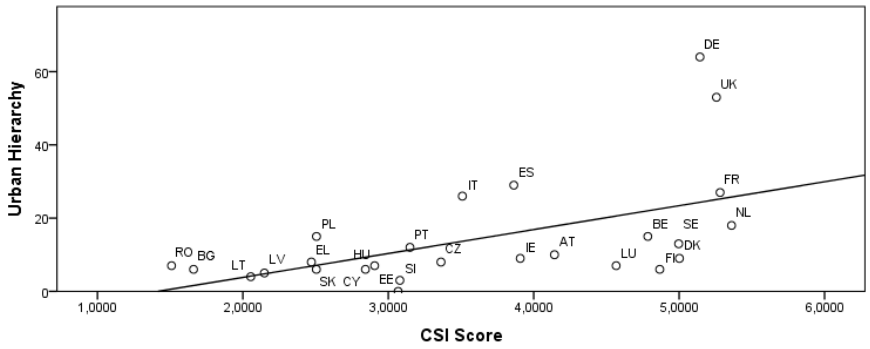

Figure 9 - Correlation between creativity and urban hierarchy

4.4.4. Polycentricity

We computed the correlation between level of polycentricity and creativity. The measure used was the morphological polycentricity according to ESPON (2007). The results show that the two variables are uncorrelated. A further research should also analyse functional polycentricity which may reveal a different relationship with creativity.

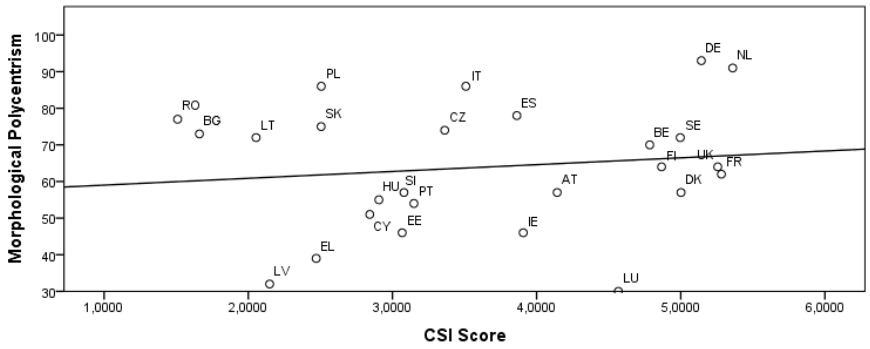

Figure 10 - Correlation between creativity and the degree of polycentricity

[7] http://www.lboro.ac.uk/gawc/world2010t.html

4.4.5. Agglomeration

In order to compute the relationship between creativity and agglomeration, we have adapted a Von Böventer's (1975) agglomeration model. Given a country's number of urban centres, *n*, their dimension, *z*, and the average distance between them, *dm*, agglomeration can be written

$$A_i = \frac{\frac{1}{n}\sum_{n=1}^{n} z_n^{\beta}}{dm^{\gamma}} \tag{4.4}$$

where β and γ capture, respectivelly, the economies of agglomeration's sensibility to urban centres dimension and the distance between them. The distance matrix[8] comprises travel-time distances by car between urban centres. Relative space was analysed instead of absolute space because it captures more characteristics of territorial dynamics. The results show a positive correlation between the two variables, which is statistically significant at the 0.05 level.

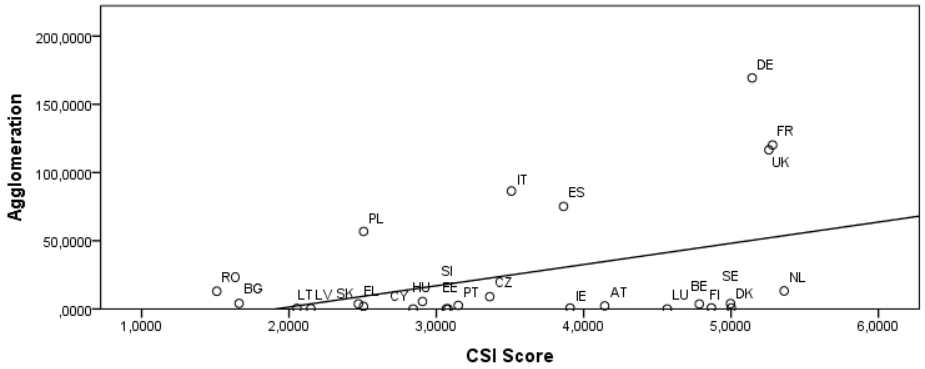

Figure 11 - Correlation between creativity and agglomeration

4.4.6. Interaction

The interaction between regions maximise each region's creative potential. Therefore, it is expectable for a more interactive country to have a better creative performance. We measured the interaction between countries with a spatial interaction model.

[8] The distance matrix was computed using Matlab and Google Distance Matrix API.

Given regions *i* and *j*, the interaction between them can be written:

$$I_{ij} = g\frac{P_i P_j}{(d_{ij})^b} \tag{4.5}$$

where the interaction, I_{ij}, depends on the capacity of the origin to generate flows, P_i, the capacity of the destination to attract flows, P_j, and the distance between them, d_{ij}. The variables *g* and *b* are, respectively, a scale factor and a parameter that measures the resistance caused by distance.

The concept of Potential consists of the interaction between city *i* and all other cities, including itself by making $d_{ii} = 1$, as shown in equation (4.6).

$$\begin{aligned}\sum_{j=1}^{n} I_{ij} &= I_{i1} + I_{i2} + \ldots + I_{ii} + I_{ij} + \ldots + I_{in} \\ &= g\frac{P_i P_1}{(d_{i1})^b} + g\frac{P_i P_2}{(d_{i2})^b} + \ldots + g\frac{P_i P_i}{(d_{ii})^b} + g\frac{P_i P_j}{(d_{ij})^b} + \ldots + g\frac{P_i P_n}{(d_{in})^b} \\ &= g\sum_{j=1}^{n}\frac{P_i P_j}{(d_{ij})^b}\end{aligned} \tag{4.6}$$

One simplifying solution of measuring Potential is using statistical data of traffic flows (Dentinho, 2011). Since traffic flows between *i* and *j* can be written

$$T_{ij} = g\frac{P_i P_j}{(d_{ij})^b} \tag{4.7}$$

one may deduce that region *i*'s Potential, as a measure of accessibility, can be written

$$Pot_i = \sum_{n=1}^{n} T_{ij}. \tag{4.8}$$

We used air traffic from European airports and the results support our expectations. There is a positive correlation between creativity and a country's level of interaction, as shown in Figure 12.

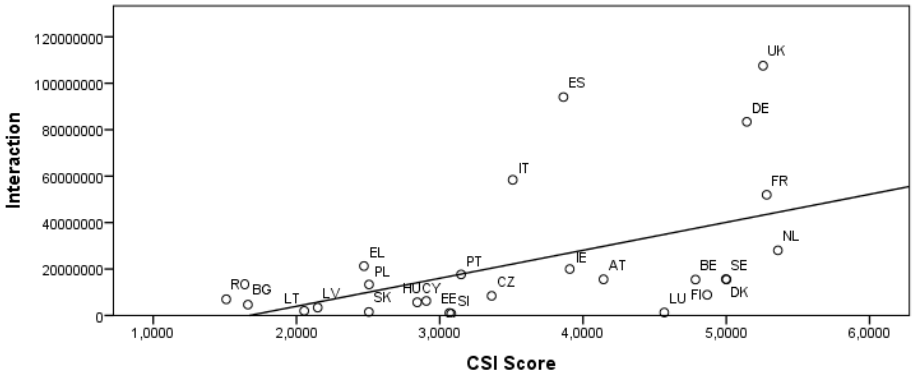

Figure 12 - Correlation between creativity and interaction

4.4.7. Multivariate analysis

The relationship between creativity and each of the analysed variables provides useful information, but it may be misleading. It is important to study how they relate to each other and how they affect creativity when analysed simultaneously. Table 18 resumes the correlation between creativity and spatial characteristics and also economic performance of EU-27 countries. All the analysed variables are positively correlated with creativity. Except for Polycentricity and Population, all spatial variables are statistically significant. The GDP per capita results are in accordance with the idea that creativity is an important economic motor, but oddly its correlation with the spatial variables are not statistically significant.

Table 18 - Correlation between creativity, spatial variables and GDP

	Score	Agglomeration	Density	Urban Hierarchy	Potential	Polycentricity	Population	GDP per capita
Score	1							
Agglomeration	0.406*	1						
Density	0.486*	0.270	1					
Urban Hierarchy	0.534**	0.926**	0.433*	1				
Potential	0.491*	0.863**	0.331	0.911**	1			
Polycentricity	0.133	0.471*	0.403*	0.465*	0.381	1		
Population	0.373	0.982**	0.305	0.903**	0.869**	0.538**	1	
GDP per capita	0.734**	0.061	0.338	0.178	0.144	-0.233	0.026	1

*. Correlation is significant at the 0.05 level.
**. Correlation is significant at the 0.01 level.

Four OLS regressions were run. Starting from one with all spatial variables and GDP as independent variables and then removing highly correlated variables to improve the quality of the regression. The OLS results reported in Table 19 show that when analysing all variables simultaneously, there is only statistical evidence to affirm that GDP has a positive impact in creativity. After running different combinations of variables, only Model 4 presented all variables with statistically significant coeficients at the 0.01 level. Although Model 4 only has one spatial variable, Potential, it captures many of the other spatial variables dynamics. As already reported in Table 18, Potential is highly correlated with Population, Agglomeration and Urban Hierarchy. It is a concept that captures the effects of scale, accessibility, traffic flows, interaction and centrality of a region. According to Model 4 which accounts for 66 percent of the variance in the dependent variable, CSI Score, both Potential and GDP per capita have a positive impact in creativity.

Table 19 - Regression results of creativity in EU-27

	Model 1	**Model 2**	**Model 3**	**Model 4**
Constant	1.276369 (0.1181)	1.838807 (0.0000)	1.881215 (0.0000)	1.989729 (0.0000)
Agglomeration	0.016599 (0.5118)	-0.002322 (0.8005)		
Population Density	0.001170 (0.5619)	0.001270 (0.4611)	0.001819 (0.2288)	
Urban Hierarchy	0.007355 (0.8649)	0.026775 (0.4741)		
Potential	1.30E-08 (0.3670)	5.82E-09 (0.6297)	1.41E-08 (0.0092)	1.60E-08 (0.0028)
Morphological Polycentricity	0.013661 (0.3043)			
Population	-3.94E-08 (0.3883)			
GDP per capita	5.10E-05 (0.0003)	4.79E-05 (0.0001)	4.84E-05 (0.0000)	5.21E-05 (0.0000)
N	26	26	26	26
Adjusted R^2	0.638003	0.649811	0.670476	0.662852

Lengend: Coeficient (*p-value*)

5. CSI EMPIRICAL APPLICATION: PORTUGUESE CITIES

The analysis of creativity at city level offers a very different perspective and complements the conclusions drawn at country level. Cities can be defined morphologically, functionally or administratively. We have applied the CSI at city level in Portugal using the administrative concept. Hereinafter, one should be aware that we will be using the term "city", but in fact we will be referring to Portuguese municipalities. This choice is mainly justified by the availability of data with this spatial unit and the ease of collecting and using it.

We have selected the largest Portuguese mainland cities with more than 100,000 inhabitants and cities with universities with more than 50,000 inhabitants, which have data that enable us to compute the index and represent about 50% of the country population. Nevertheless, we still had to reduce the index to 25 indicators and adapt some of them, as presented in Table 20. Due to the elimination of part of the original indicators, the dimensions have gained a disproportional weight in the overall score. Therefore, the Portuguese CSI aggregation is done by giving equal weights to each indicator instead of having the original equally weighted dimensions.

Table 20 - Portuguese CSI dimensions, indicators and description

Dimension	Indicator	Description
D1 - Talent	Human capital	Nr of graduates per capita
	Creative class	Share of persons employed in creative enterprises
	Education	Nr higher education establishements per thousand inhab.
D2 - Openness	Diversity	Share of non-nationals among residents
	Tolerance	Share of marriages between individuals of same gender
D3 - Cultural Environment and Tourism	Cultural offering	Nr event facilities, museums and art galleries per 1000 inhab.
	Cultural participation	Nr of visitors per live show, museum and art gallery
	Tourism capacity	Nr of bed-places per capita
	Tourism occupancy	Tourism establishments occupancy rate
D4 - Technology and Innovation	R&D	R&D expenditure as percentage of GDP
	HRST	Percentage of human resources in science and technology
	Internet access	Nr of computers with internet access at schools per capita
	Patents	Nr of patents registered per thousand inhabitants

Dimension	Indicator	Description
D5 - Industry	Creative industries	Share of creative enterprises
	Value added	Value Added of creative industries per thousand inhab.
	Turnover	Turnover in creative industries per thousand inhab.
D6 – Regulation and Incentives	Public incentive	Direct public expenditure on culture per capita
D7 - Entrepreneurship	Startups	Birth rate of enterprises
D8 - Accessibility	Road	Length of motorway per area
	Rail	Length of railway per area
D9 - Liveability	Purchase power	Purchase power (Portugal=100)
	Crime	Nr of recorded crimes per thousand inhabitants
	Health Care	Nr of physicians per thousand inhabitants
D10 - Notoriety	Capitals of culture	Nr of times elected UNESCO capital of culture
	Heritage	Nr of monuments and other cultural properties

By looking at Table 21, it is clear that Portugal has two main creative cores: Lisbon and Oporto, showing the scores of 7.99 and 6.35, respectively. These cities are two unquestionable creative leaders, followed then by Cascais, Oeiras, Portimão, Coimbra, Loulé and Mafra with scores between 3 and 5. There are eight cities with scores below 1 and the last place is taken by Marco de Canaveses. The amplitude of the Portuguese CSI scores is much bigger when compared to European CSI (1.51-5.36). This means that creativity is even more heterogeneous when assessed at city level in Portugal than at country level in Europe.

Table 21 - Portuguese Creative Space Index

City	Score	Rank	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Lisboa	7.99	1	0.64	0.87	1.00	0.79	0.66	1.00	0.83	0.88	0.87	0.76
Porto	6.35	2	0.78	0.45	0.80	0.51	0.46	0.81	0.45	0.81	0.80	0.61
Cascais	4.32	3	0.36	0.69	0.31	0.86	1.00	0.63	0.83	0.32	0.36	0.05
Oeiras	3.51	4	0.22	0.54	0.10	0.93	0.59	0.61	0.83	0.55	0.39	0.01
Coimbra	3.16	5	0.70	0.27	0.28	0.59	0.16	0.72	0.41	0.25	0.62	0.05
Guimarães	2.76	6	0.05	0.07	0.08	0.34	0.03	0.35	0.24	0.17	0.09	0.55
Évora	2.75	7	0.35	0.30	0.44	0.36	0.22	0.81	0.50	0.17	0.23	0.08
Faro	2.75	8	0.50	0.84	0.29	0.23	0.18	0.57	0.68	0.15	0.44	0.02
Almada	2.41	9	0.29	0.70	0.09	0.38	0.22	0.44	1.00	0.14	0.26	0.01
Amadora	2.38	10	0.10	0.56	0.03	0.74	0.20	0.14	0.83	0.53	0.27	0.01
Setúbal	2.32	11	0.22	0.47	0.15	0.29	0.20	0.43	1.00	0.37	0.24	0.03

City	Score	Rank	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Sintra	2.24	12	0.11	0.51	0.02	0.65	0.17	0.25	0.83	0.26	0.10	0.07
Aveiro	2.23	13	0.41	0.25	0.23	0.66	0.15	0.00	0.31	0.32	0.36	0.01
Vila Franca de Xira	2.13	14	0.08	0.31	0.04	0.82	0.17	0.27	0.83	0.20	0.10	0.02
Matosinhos	2.11	15	0.15	0.12	0.08	0.43	0.16	0.77	0.45	0.63	0.29	0.02
Loures	2.09	16	0.09	0.44	0.01	0.76	0.15	0.11	0.83	0.22	0.25	0.02
Odivelas	2.06	17	0.13	0.37	0.01	0.95	0.13	0.11	0.83	0.00	0.10	0.01
Braga	2.04	18	0.25	0.15	0.14	0.53	0.09	0.65	0.36	0.17	0.22	0.05
Seixal	1.96	19	0.14	0.26	0.02	0.38	0.22	0.53	1.00	0.22	0.11	0.01
Viseu	1.92	20	0.36	0.11	0.17	0.23	0.20	0.95	0.15	0.18	0.15	0.03
Covilhã	1.77	21	0.30	0.15	0.18	0.35	0.16	0.66	0.33	0.08	0.07	0.01
Vila Nova de Gaia	1.77	22	0.14	0.20	0.08	0.34	0.17	0.73	0.45	0.31	0.14	0.01
Maia	1.76	23	0.11	0.08	0.06	0.55	0.08	0.59	0.45	0.43	0.19	0.00
Santarém	1.73	24	0.29	0.15	0.10	0.24	0.16	0.46	0.56	0.12	0.19	0.04
Leiria	1.35	25	0.22	0.19	0.16	0.35	0.10	0.41	0.00	0.13	0.13	0.01
Gondomar	1.16	26	0.10	0.02	0.01	0.38	0.10	0.26	0.45	0.20	0.08	0.00
Vila Nova de Famalicão	1.10	27	0.09	0.02	0.05	0.34	0.07	0.35	0.24	0.29	0.05	0.01
Barcelos	0.95	28	0.06	0.01	0.02	0.29	0.00	0.39	0.36	0.19	0.00	0.02
Santa Maria da Feira	0.78	29	0.07	0.02	0.06	0.32	0.04	0.15	0.06	0.15	0.07	0.01
Paredes	0.70	30	0.13	0.00	0.01	0.10	0.05	0.33	0.17	0.16	0.03	0.01

Source: Author

The Portuguese municipalities have very different structures and in some cases the administrative boundaries do not generate comparable spatial units. This problem is particularly more relevant when comparing Lisbon or Oporto. Many of the analysed municipalities are part of their functional urban zone and together they act as a single urban unit.

To overcome this problem, we decided to use the statistical units known as Greater Lisbon (Grande Lisboa) and Greater Oporto (Grande Porto)[9]. They comprise several municipalities which are centred around the cities of Lisbon and Oporto, and share functions and resources with the core cities. The municipalities that compose the Greater Lisbon zone were all part of the selection presented in Table 21, which listed only seven from the nine municipalities of Greater Oporto.

[9] Defined according to Statistics Portugal (INE), the used source for collecting indicators data.

Table 22 - Municipalities of Grande Lisboa and Grande Porto

Grande Lisboa	Grande Porto
Amadora	Espinho*
Cascais	Gondomar
Lisboa	Maia
Loures	Matosinhos
Mafra	Porto
Odivelas	Póvoa de Varzim
Oeiras	Valongo
Sintra	Vila do Conde*
Vila Franca de Xira	Vila Nova de Gaia

**below 50000 inhabitants and not included in the previous index*

The results presented in Table 23 reveal some differences in CSI scores caused by the inclusion of Greater Lisbon and Greater Oporto units. Lisbon remains the index leader but its score has decreased from 7.99 to 6.59. Oporto also decreased from 6.35 to 4.62. One may conclude that Lisbon and Oporto creativity is relatively higher in the core and it dilutes when adressing its creative performance at the larger functional urban level. Greater Lisbon comprises municipalities that also score relatively better in the CSI, that is why when analysed at its larger urban functinal unit, Lisbon still ranks first.

Table 23 - Portuguese CSI with Great Lisbon and Great Oporto

City	Score	Rank	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Grande Lisboa	6.59	1	0.42	0.64	0.29	0.66	0.56	0.47	0.83	0.36	0.36	1.00
Grande Porto	4.62	2	0.43	0.19	0.19	0.36	0.35	0.64	0.45	0.46	0.26	0.69
Coimbra	3.41	3	0.83	0.27	0.28	0.69	0.19	0.72	0.41	0.26	0.62	0.04
Faro	2.95	4	0.64	0.84	0.29	0.28	0.21	0.57	0.68	0.15	0.44	0.01
Évora	2.87	5	0.35	0.30	0.43	0.48	0.24	0.81	0.50	0.16	0.23	0.07
Guimarães	2.81	6	0.11	0.07	0.07	0.35	0.04	0.35	0.24	0.17	0.09	0.54
Almada	2.65	7	0.48	0.70	0.09	0.43	0.25	0.44	1.00	0.12	0.26	0.00
Setúbal	2.55	8	0.37	0.47	0.15	0.35	0.23	0.43	1.00	0.38	0.24	0.02
Aveiro	2.50	9	0.52	0.25	0.23	0.80	0.18	0.00	0.31	0.34	0.36	0.01
Seixal	2.20	10	0.33	0.26	0.02	0.42	0.25	0.53	1.00	0.21	0.11	0.00
Viseu	2.17	11	0.55	0.11	0.16	0.24	0.29	0.95	0.15	0.17	0.15	0.02
Braga	2.16	12	0.35	0.15	0.13	0.56	0.11	0.65	0.36	0.17	0.22	0.04
Covilhã	1.92	13	0.44	0.15	0.18	0.37	0.18	0.66	0.33	0.06	0.07	0.01

City	Score	Rank	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Santarém	1.84	14	0.40	0.15	0.09	0.24	0.18	0.46	0.56	0.11	0.19	0.03
Leiria	1.48	15	0.33	0.19	0.15	0.36	0.13	0.41	0.00	0.13	0.13	0.00
Vila Nova de Famalicão	1.17	16	0.15	0.02	0.04	0.36	0.08	0.35	0.24	0.31	0.05	0.00
Barcelos	0.97	17	0.06	0.01	0.02	0.34	0.00	0.39	0.36	0.19	0.00	0.01
Santa Maria da Feira	0.82	18	0.13	0.02	0.06	0.32	0.05	0.15	0.06	0.15	0.07	0.00
Paredes	0.75	19	0.20	0.00	0.01	0.10	0.06	0.33	0.17	0.16	0.03	0.00

Source: Author

Except for Lisbon, all cities score below 5.00, this means that they are still more than half the way to reach a good score and there is still much to do in order to improve their creative performance. By looking at Figure 13 it is clear that creativity is mainly concentrated around Lisbon and Oporto, as expected. Further research should include all Portuguese cities for a complete perception of creativity distribution on territory which would enable an analysis under a contiguity perspective.

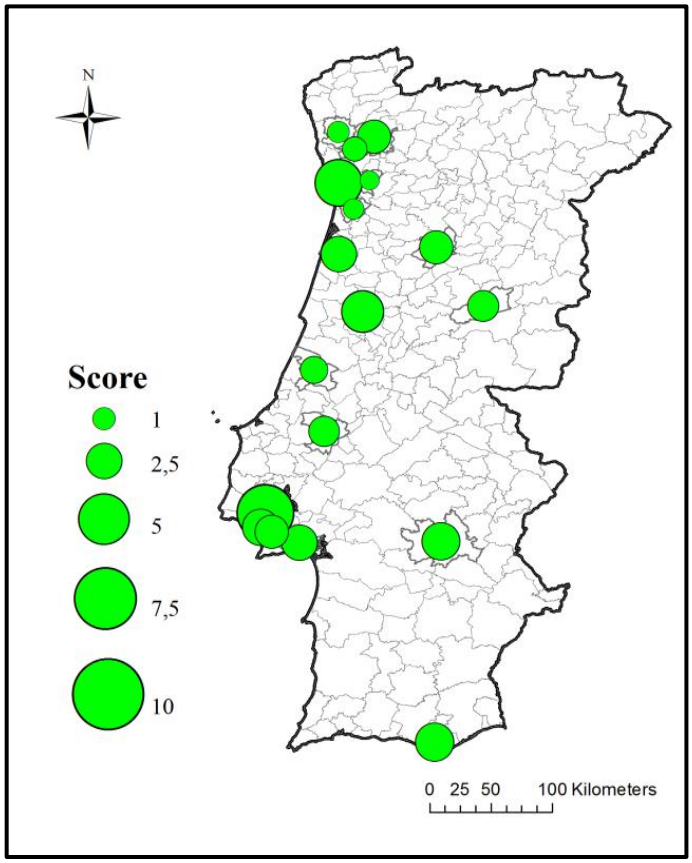

Figure 13 - Portuguese CSI map

5.1. Creativity and space at city level

Analogously to what has been done at country level, we present an analysis on the relationship between creativity measured by CSI Score and a selected group of variables: Area, Population, Density and Potential. The number of the analysed spatial characteristics is smaller than the one used at country level due the lack of data availability of data or the irrelevance of their analysis at city level. Instead of using air traffic to measure Potential, at city level we calculated the number of interactions between territorial units with commuting statistics.

Table 24 - Correlation between creativity and spatial variables

	Score	Area	Population	Density	Potential
Score	1				
Area	0.611**	1			
Population	0.808**	0.627**	1		
Density	0.329	-0.152	0.449	1	
Potential	0.819**	0.595**	0.979**	0.478*	1

*. Correlation is significant at the 0.05 level.
**. Correlation is significant at the 0.01 level.

Except for Density, individually all variables have a significant correlation with CSI Score at the 0.01 level. The Potential is correlated with all variables supporting the fact that it is a concept that individually captures many other spatial characteristics of a region.

The OLS results reported in Table 25 show that when running a regression with all the selected variables simultaneously, none of them have statistically significant coeficients. When running regressions with new combination of variables by removing the ones with high correlations, the results have some changes. Models 2, 3 and 4 present a statistically significant coeficient for Potential and one may conclude that it has a positive impact on creativity at city level, just like at country level. Model 4 is a regression estimated only with Potential as an independent variable, but, just like at country level, it seems to capture much of other spatial dynamics.

Table 25 - Regression results of creativity in Portuguese cities

	Model 1	**Model 2**	**Model 3**	**Model 4**
Constant	1.534762 (0.0070)	1.541306 (0.0047)	1.622918 (0.0000)	1.822580 (0.0000)
Area	0.000788 (0.3602)	0.000768 (0.3381)	0.000663 (0.2790)	
Population	-1.77E-07 (0.9296)			
Population Density	9.13E-05 (0.8302)	8.83E-05 (0.8293)		
Potential	8.82E-06 (0.3457)	8.06E-06 (0.0194)	8.54E-06 (0.0008)	9.93E-06 (0.0000)
N	19	19	19	19
Adjusted R^2	0.608716	0.634591	0.656329	0.651161

Lengend: Coeficient (*p-value*)

6. A PROPOSAL FOR A NEW TYPOLOGY OF CITIES

Although most policymakers and administrators are becoming more and more aware of creativity importance for local development, they have little idea where to start and scarce tools to support the decision-making process. The CSI provide vital information about cities' creative performance. But, in order to increase creativity policy effectiveness, we developed another tool that complements the CSI: the Creative City Matrix (CCM). Many studies have proved the importance of proximity to highly creative cities and the existence of spatial dependence (e.g., Acs *et al*, 2009; Kloudova *et al*, 2010). The CCM highlights the proximity matter and provides a typology based on cities' creativity and their distance to creative centres. By basing their considerations on the CSI overall scores and each dimension performance together with the CCM typology, policymakers and administrators have conditions to compile better measures.

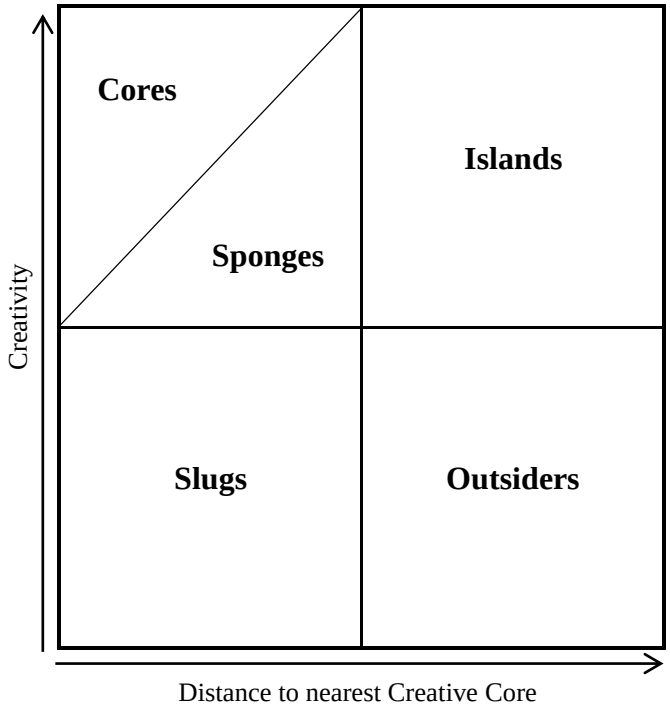

Figure 14 - Creative City Matrix

Source: Author

The rationale behind the CCM is that, depending on its type, a city should have a specific plan to improve its creative performance. Although every city wishes to be a Core, that does not mean that, after becoming one, the need of a creative strategy decreases. Every city has its own challenges; big or small the important thing is knowing how to solve them. The CCM is a tool for policymaking which helps to define priorities among the different operating areas.

Table 26 - CCM types and description

Type	Description
Cores	Creative epicentres which are usually centres of creative networks.
Sponges	Cities with high creativity potential due to the proximity to Core cities and the ability to absorb and take advantage of it.
Islands	Cities with high creativity potential although they are located far from Core cities. Usually, Islands are creative clusters from a specific activity or a city that has a distinguishing cultural theme.
Slugs	Even though they are located near Cores, these cities have low creativity potential. They are unable to take advantage, communicate and absorb the surrounding creativity.
Outsiders	Cities with low creativity potential and far from Cores.

Source: Author

While Sponges are cities that take advantage of their proximity to Cores and invest in the maximisation of creative spillovers, Slugs are cities that are unable to absorb the surrounding creativity. This exemplifies how cities that are equally near the creative Core may have very different performances in terms of creativity and different challenges to overcome. Similarly, cities that are equally far from Cores and have identical spatial characteristics, may have different creative performances which results in different policy implications.

6.1. CCM application: Portuguese Cities

Using the CSI results we classified Portuguese cities according to the Creative City Matrix typology. We defined one hour by car as the limit between far and near to creative Cores and the tenth place at CSI Rank as the limit between high and low Creativity. According to CCM typology, Lisbon and Oporto are the two Portuguese creative Cores and the former has three surrounding Sponges (Almada, Setúbal and Seixal), while the latter has two (Aveiro and Guimarães). There are three Islands: Coimbra, Faro and Évora. There are two Outsiders, Covilhã and Viseu, the rest of the cities are Slugs.

Table 27 - CCM application: Portuguese cities

Type	Cities
Cores	Lisbon and Oporto
Sponges	Almada, Setúbal, Aveiro, Seixal and Guimarães
Islands	Coimbra, Faro, Évora
Slugs	Braga, Santarém, Leiria, Vila Nova de Famalicão, Barcelos, Santa Maria da Feira and Paredes
Outsiders	Covilhã, Viseu

7. CONCLUSION

The interest in the estimation of indexes of creativity has been increasing in the last years, not only for territorial marketing purposes, but also, because they provide analytical tools to assess the economic impact of the creative economy and are useful to measure the effectiveness of political decisions. However, there is still not an established index accepted by the majority and widely used. The literature review on creativity indexes presented in Chapter 2 highlighted their main gaps and weaknesses which served as a basis for designing our own index.

In the last decade it has been produced a considerable amount of literature on creativity, but it still remains a subject that resists economic analysis due to the ambiguity inherent to the subject itself and the difficulty of measuring such a complex and subjective phenomenon. There are several different approaches to the analysis of creativity but all agree on one thing: creativity is the new motor of economic development. Our calculations also support that idea. According to the results obtained at country level by testing the CSI in EU-27 member states, there is a statistically significant positive correlation between creativity and economic performance. However, there is no evidence wether higher creativity is the cause or the consequence of better economic performance, and vice versa; or if they mutually feed each other.

One of the main aims of this dissertation was to draw attention to the spatial analysis which has been overlooked by the existing studies on creativity and, consequently, by creativity indexes. First, we designed the CSI with an underlying spatial theory inspired by gravitational models. Second, we analysed the relationship of the CSI scores with spatial variables individually and simultaneously. The main conclusion is that the level of interactivity is an important leverage of creativity, both at country and city level. For measuring interactivity we used the concept of Potential which is highly correlated with other variables, such as scale, accessibility, traffic flows, proximity and centrality; therefore, capturing many of their dynamics. We also conlude that while in European countries creativity is higher in Central Europe and it dilutes when moving to the periphery, in Portuguese cities there is no clear pattern of centrality. Lastly, we

proposed a new tool which aims to complement creativity indexes and to support the policy and decision making process: the Creative City Matrix. It defines the type of city according to its creative performance and its distance to creative centres of excellence. By testing it in Portuguese cities using the CSI scores obtained in Chapter 5, we concluded that Portugal has two creative Cores: Lisbon and Oporto. These two cities are surrounded by Sponges and Slugs. While the former take advantage of their proximity to the Cores, the latter seem to be unable to absorb the creativity from the near Core and maximise existing potential spillovers. Three cities located far from the Cores - Coimbra, Évora and Faro - still rank relatively well in the CSI, enabling us to conclude that it is possible to be creative even far from the Cores. Albeit, we must be aware that the results and conclusions are based on testing a sample that only represents part of the Portuguese cities.

There are several options to extend this dissertation in further research:

- Refinement of the index methodology;
- Update of the index on a time basis for trend analysis;
- Extension of the European analysis to regions and cities;
- Extension of the Portuguese analysis to all cities;
- Analysis of the relationship of creativity with other spatial variables using more advanced statistical and econometric methods.

However, most of these possibilites are limited to the same challenges faced by this dissertation, most of them concerning data availability, collection and manipulation. Since there is still no commonly accepted framework on creativity, there is no database for creativity and data has to be collected from different sources individually and then compiled altogether. The indicators are not always available for the same territorial unit and for the same year. This problem is even bigger when doing the analysis at city level, which has proved to be the best and natural environment of creativity. At European level there is already a database of cities' vitality, the Urban Audit, that already holds some creativity indicators and which could be extended to address this phenomenon. In Portugal, there is a database for Cultural Statistics but it also needs to extend its indicators to other creative fields and provide data at city level.

Despite the limitations of this dissertation, we believe that it has produced a relevant contribution in the context of the Creative Economy and, particularly, of the creativity indexes.

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ATTACHEMENTS

Country	Agglomeration	Density	Urban Hierarchy	Potential	Polycentrism	Population	GDP pc
Belgium	3.62	358.7	15	15442618	69.6	10951266	32600
Bulgaria	4.11	69.1	6	4645378	73.2	7504868	4800
Czech Republic	9.00	136.2	8	8441703	74.2	10532770	14200
Denmark	0.81	128.7	9	15477167	56.6	5560628	42500
Germany	169.38	229.0	64	83406962	93.4	81751602	30300
Estonia	0.12	30.9	0	1089926	45.6	1340194	10700
Ireland	0.70	65.4	9	19983202	45.8	4480858	34900
Greece	3.73	86.4	8	21281235	38.6	11309885	20100
Spain	75.17	91.8	29	94055445	77.6	46152926	22800
France	120.18	102.5	27	51955175	62.4	65048412	29900
Italy	86.46	200.7	26	58395624	86.2	60626442	25700
Cyprus	0.00	87.2	6	5662642	51.4	804435	20600
Latvia	0.19	36.0	5	3395120	32.2	2229641	8600
Lithuania	0.47	52.4	4	1978996	72	3244601	8400
Luxembourg	0.00	196.0	7	1261800	30	511840	79500
Hungary	5.47	107.5	7	6266701	54.8	9985722	9700
Netherlands	13.20	492.2	18	28028933	90.8	16655799	35400
Austria	2.25	101.8	10	15553224	56.8	8404252	34100
Poland	56.82	122.1	15	13319110	85.6	38200037	9300
Portugal	2.66	115.4	12	17674285	54.4	10636979	16200
Romania	13.01	93.2	7	6968124	77.2	21413815	5800
Slovenia	0.09	101.7	3	773423	56.8	2050189	17300
Slovakia	1.87	110.7	6	1506496	74.8	5435273	12100
Finland	0.80	17.6	6	8887886	63.6	5375276	33500
Sweden	3.95	22.9	13	15664912	71.8	9415570	37200
United Kingdom	116.61	254.2	53	107553330	63.8	62498612	27500

Attachement 1 – Spatial variables of EU-27

City	Score	Area	Population	Density	Potential
Almada	2.65	70.2	165758	2361.225	65085
Aveiro	2.50	197.6	72601	367.414	26239
Barcelos	0.97	378.9	124395	328.3056	18539
Braga	2.16	183.4	177940	970.229	35752
Coimbra	3.41	319.4	131446	411.5404	43082
Covilhã	1.92	555.6	51145	92.05364	5277
Évora	2.87	1307.1	54111	41.39775	7106
Faro	2.95	201.8	58625	290.5104	16947
Guimarães	2.81	241	162313	673.4979	28846
Leiria	1.48	565.1	129745	229.5965	21449
Lisboa	6.25	1376.7	2036181	1479.03	468104
Paredes	0.75	156.8	87632	558.8776	20398
Porto	4.34	814.7	1286111	1578.631	199356
Santa Maria da Feira	0.82	215.9	149337	691.6952	29654
Santarém	1.84	560.2	63149	112.7258	12741
Seixal	2.20	95.5	180741	1892.576	57021
Setúbal	2.55	230.3	126013	547.1689	30480
Vila Nova de Famalicão	1.17	108.5	135959	1253.078	29023
Viseu	2.17	507.1	99737	196.6811	11638

Attachement 2 – Spatial variables of Portuguese cities